

National Aeronautics and Space Administration

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NASA ADVISORY COUNCIL

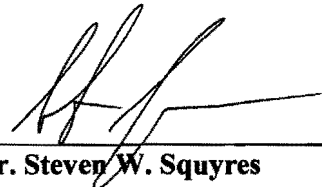
March 8-9, 2012

**NASA Headquarters
Washington, DC**

MEETING MINUTES



**P. Diane Rausch
Executive Director**



**Dr. Steven W. Squyres
Chair**

NASA ADVISORY COUNCIL**NASA Headquarters****Washington D.C.****March 8-9, 2012****Meeting Minutes****Table of Contents**

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*Report prepared by
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The NASA Advisory Council public meeting on Thursday, March 8, 2012, convened at 8:00 am.

Call to Order: Announcements

Ms. Diane Rausch, Executive Director

Ms. Diane Rausch, Executive Director, NASA Advisory Council (NAC), called the meeting to order and welcomed the NAC members to NASA Headquarters and Washington, DC. She noted the NAC was a chartered Federal advisory committee under the Federal Advisory Committee Act (FACA) of 1972. As a FACA committee, she said, the session was open to the public; a dial-in teleconference and WebEx capability had been established to increase public accessibility. She asked members of the public not to interrupt the speakers, and noted that time had been made available on the agenda for public input at the end of each day. Ms. Rausch added that the session was a public meeting, and as such, all comments were on the record. Written minutes would also be produced after the meeting and posted to the NAC website, along with copies of all presentations. She noted that each NAC member had been appointed by the NASA Administrator, Mr. Charles F. Bolden, Jr., based on the member's expertise. Each member served as a Special Government Employee, and, as such, was subject to Federal ethics laws and regulations. She noted that the required annual ethics briefing for Council members would take place over lunch that day. She then introduced Dr. Steven W. Squyres, the Council Chair.

Remarks by Council Chair

Dr. Steven W. Squyres, Chair

Dr. Steven Squyres, Council Chair, greeted the Council members and thanked them for attending the first NAC meeting of 2012. He noted that this was his first meeting as Council Chair, and addressed several matters related to the NAC committees. Several committee chairs had expressed the need for additional members, and he indicated his support of this. He said he intended to schedule meetings far in advance to facilitate Council member attendance, starting with the remainder of 2012. Dr. Squyres suggested it may at times be beneficial for committees to meet jointly on matters of shared interest. For example, one committee noted that NASA spacecraft will be generating huge volumes of data; a second committee could be looking at how to create infrastructure for housing this data. In general, he said, the NAC's primary work was done at the committee level. He would ensure that the committees' important views were deliberated by the Council and reached the NASA Administrator; he did not want the Council to be a "high density filter" for committee advice and recommendations. Council members, he said, had not been asked to be cheerleaders. Council members should not be shy; they should freely give advice to NASA. He urged that all recommendations be actionable; that is, framed so they can be implemented. Finally, he noted that the NAC structure consisted of committees with assigned responsibilities. This arrangement opened the possibility of potential gaps. With some issues falling between committees; he urged all to be mindful of this. Dr. Squyres said he intended to start and end Council meetings on time. He regarded it as very important that all members feel that they had been heard. Before any NAC meeting adjourned, therefore, he would seek final comments from each member via a roundtable discussion to ensure everyone's voice is heard.

Remarks by NASA Administrator

Mr. Charles F. Bolden, Jr.
NASA Administrator

Administrator Charles F. Bolden said that before giving his prepared remarks, he wished to thank those who had traveled from out of town. He noted that shortly after he arrived as NASA Administrator in July 2009, he made the decision to decrease the size of the Council to encourage informal exchange; the previous evening's dinner had been one such occasion. He noted that two newly-appointed members were in attendance: Ms. Patti Grace Smith and Dr. William Ballhaus, and added that third newly-appointed member, General Lester Lyles, had a prior commitment to attend a White House meeting. He thanked all NAC members for participating, assuring members that he took their recommendations seriously. He urged that they be candid in their findings and recommendations, "even when it hurts," as otherwise their comments had little use. He thanked Dr. Alan Boss for substituting at this meeting for Dr. Wesley Huntress, Jr., who had recently taken ill.

Administrator Bolden reported that President Obama's FY 2013 Budget Request had recently gone to Congress; he had testified yesterday before the Senate and House of Representatives space subcommittees. He characterized these meetings as "unusually spirited, but very productive." He noted that the President's FY 2013 request for NASA was for a \$17.7 billion "stable" budget. Administrator Bolden noted that the stable budget was a relief to "our European partners," who were pleased that NASA still wishes to undertake Mars work in collaboration with the European Space Agency [ESA]. He noted that there had been a lot of debate about NASA's direction over the past several years, but that time is over. The Congress and the President have agreed on a direction and now NASA is implementing the blueprint for space exploration that will take the nation farther into the solar system than ever before. Administrator Bolden said the President and Congress had identified the three top Agency priorities:

- International Space Station [ISS]
- Heavy-lift launch vehicle, known as the Space Launch System [SLS]
- James Webb Space Telescope [JWST]

The Agency continued, through aviation and space breakthroughs, to enable missions never before attempted. He noted that “tough decisions” had been made on funding, but NASA retained a balanced portfolio of human exploration, science, technology development, aeronautics, and education work.

Administrator Bolden noted that NASA had made steady and tangible progress on the next generation deep space crew capsule and the new heavy lift rocket. The first test firings of the J-2X engine that will power the upper stage of the heavy lift launch vehicle had occurred at Stennis Space Center. The Orion crew vehicle had undergone water drop tests for its eventual ocean landing, as well as parachute drop tests. NASA has continued to maintain an American presence in space onboard the International Space Station. Administrator Bolden said he remained committed to launching astronauts from American soil, on spacecraft built by American companies. In 2012, there will be the first ever launch and berthing of a spacecraft by a private company. This is a critical and historic milestone, he said. The SpaceX launch was scheduled for April 30, 2012. Another private company, Orbital Sciences Corporation, would also launch sometime this summer, and could make its first commercial flight by year’s end. He noted that NASA just recently issued an announcement for proposals for the next round of commercial crew acquisition activities. For 12 years, the ISS orbiting laboratory had permitted work not otherwise possible. He called attention to a new publication that has also been posted to the NASA website, entitled, “ISS: Benefits for Humanity,” which focused on the benefits brought to Earth by ISS.

Administrator Bolden said that NASA had just concluded its latest call for astronauts and more than 6,300 individuals had applied, the second highest total ever. The 2013 class will join the class of 2009 that just graduated. He said that it is clear that young people are still very much interested in being a part of NASA and helping to shape the future of exploration. He noted that these new astronauts are the first space travelers that could one day each an asteroid and will pioneer the path for future astronauts to set foot on Mars. He noted that today’s astronauts were trained to a higher standard, adding, “I could not make it today.” When he had been in astronaut training, it had been a “one year’s gentleman’s course.” Today, there was a two-year evaluation; everything done was graded. He noted that he came through the program as a pilot without mastery of a specialty. Today, he said, three specialties were required: first, astronauts had to be fluent in Russian, so they could function aboard the Soyuz spacecraft; second, astronauts needed to know how to operate robotic systems; and third, all had to be qualified to spacewalk. The applicants were incredibly diverse in background. No decision had yet been made on how many applicants would be selected. The astronaut corps was currently 65, which Peggy Whitson, NASA’s head astronaut, considered insufficient for ISS, commercial spacecraft and other responsibilities. Administrator Bolden noted that members of the incoming astronaut class might set foot on an asteroid or pioneer for future astronauts that set foot on Mars.

Administrator Bolden discussed developments in other fields, starting with space technology, including work on solar-electric propulsion, lightweight cryogenic propellant tanks. He noted the three technology demonstration mission proposals NASA selected the past year to transform space laser communications, deep space navigation using atomic clocks, and in-space propulsion capabilities, including solar sails. He noted that in 2011, NASA provided 80 space technology research fellowships to graduate students; the proposed FY 2013 budget continued this important initiative. In aeronautics, he said, NASA efforts are driving breakthroughs for cleaner, safer, and more efficient aircraft. He called attention to the Boeing 787, “an incredibly beautiful aircraft, simple in its complexity,” with huge windows and simple controls. A Boeing official has told him that most of the technological development had been done by NASA. The 787 was so quiet, he noted, that engine tests could be conducted 24/7 without violating the 11:00 pm noise curfew in Everett, Washington.

In education, Administrator Bolden said NASA is focusing on programs with a measurable return, to help feed the pipeline that is so urgently needed for new engineers and scientists to share their energies, passions, and great intelligence. It was not enough to say 10,000 children had been reached; it was necessary to know how they had been engaged and what they had learned. NASA had for the past two summers focused on a pilot project called “Summer of Innovation” directed at middle school age students and their teachers, giving them an intense exposure to science and math. He said many public school teachers lacked comfort teaching science and math because they themselves were not comfortable with the subjects; this needed to be addressed.

In science, Administrator Bolden noted that work continued on the James Webb Space Telescope [JWST] leading to its planned launch in 2018. A recent milestone was the cryogenic testing of the final six JWST mirror segments. This milestone represents the successful culmination of a process that took years and broke new ground in manufacturing and testing large mirrors. JWST, like the Hubble Space Telescope, would expand human understanding of the universe. Administrator Bolden stated that the President’s FY 2013 budget request for NASA supported over 80 science missions, 56 currently in operation and 28 now under development. He noted that the current fiscal environment had forced difficult decisions: NASA would not be moving forward with the 2016/2018 ExoMars missions that it had been exploring with ESA. The proposed budget provided support for a new approach. He noted that he had tasked the head of the NASA’s Science Mission Directorate, Dr. John Grunsfeld, the head of NASA’s Human Exploration, Mr. Bill Gerstenmaier, NASA’s Chief Technologist, Dr. Mason Peck, and NASA’s Chief Scientist,

Dr. Waleed Abdalati, to craft an integrated Mars strategy that will ensure that the next steps for the robotic Mars exploration program will support science as well as long-term human exploration goals, and potentially take advantage of the 2018 launch window.

Administrator Bolden said the FY 2013 NASA budget request was intended to keep the U.S. the world leader in space exploration and showcase our problem-solving capabilities and improving life here on Earth. Administrator Bolden said he was optimistic about NASA's future. He noted that the previous week he had met in Quebec, Canada with NASA's ISS heads of agencies; he was impressed by great enthusiasm by NASA's ISS partners – Canada, Japan, ESA, and Russia.

Administrator Bolden noted other achievements since the last NAC meeting was held at NASA Ames Research Center in August 2011. After announcing the new design of the new Space Launch System, NASA added an unpiloted flight test of the Orion spacecraft in early 2014 to the contract with Lockheed Martin Space Systems. The Exploration Flight Test (EFT-1) will fly two orbits to a high apogee and make a high energy reentry through earth's atmosphere. Orion will then land off the California coast and be recovered using operations planned for future human exploration missions. Last September 2011, NASA and ATK Space Systems successfully completed a two-minute full-scale test of Development Motor-3, NASA's largest solid fuel rocket engine ever designed for flight.

In December 2011, NASA announced a modified approach to supporting commercial crew capability. The Agency will competitively award Space Act Agreements for the next phase of the Commercial Crew Program instead of awarding contracts. This move will keep NASA's plan on track for U.S. companies to transport U.S. astronauts into space; it will ultimately end outsourcing the work to foreign governments. And just last month, NASA issued a call for industry to submit proposals for the Commercial Crew Integrated Capability Initiative. Looking ahead, Administrator Bolden noted that in 2012, the Mars Science Laboratory [MSL] rover on its way to Mars for an August 2012 landing will demonstrate precision landing technology; it is the most sophisticated rover ever sent to the Red Planet. The Juno spacecraft is en route to Jupiter for a 2016 arrival; and the Gravity Recovery and Interior Laboratory [GRAIL] twin spacecraft were inserted into lunar orbit on New Year's Eve and New Year's Day. GRAIL-A and GRAIL-B were recently renamed "Ebb" and "Flow." These names were proposed by a student in Bozeman, Montana. This, he noted, was not because of any association with the tides, but reflected the manner in which the twin satellites followed each other around the planet. Administrator Bolden said recent launches had attracted crowds of over 10,000 people; they were crowding the Kennedy Space Center causeway in Florida to see the launch of a NASA science mission. The enthusiasm, he said, matched or exceeded that of the later Space Shuttle launches, although not the final ones. Administrator Bolden noted that NASA was using social media it had known nothing about two years ago. People remained fascinated by launches: a vehicle leaving the planet was special. He noted that the Kepler mission had identified 11 new planetary systems hosting 26 confirmed planets. These discoveries nearly doubled the number of verified planets and tripled the number of stars known to have more than one planet that transits the star. Kepler has now confirmed 61 exo-planets and 2,321 candidate planets. Administrator Bolden noted that in two weeks, another great science mission, the Nuclear Spectroscopic Telescope Array [NuSTAR], will launch to study massive black holes, supernovae and other high energy sources in the universe.

Administrator Bolden stated that the NASA Space Technology Program had more than 1,000 projects underway, almost all of which were competitively-selected, ranging across all technical areas and all levels of technical maturity. Many involved small business ventures that were minority, women or veteran-owned. In September, NASA awarded \$1.5 million in prizes for hyper-efficient aircraft at the Green Flight Challenge, heralding a new industry for electric aircraft. He noted that the first Technology Development Mission, the MSL Entry, Descent and Landing Instrument [MEDLI] suite, launched with MSL in November 2011.

Administrator Bolden closed by saying that he was looking forward to receiving the Council's findings and recommendations. NASA was fortunate to have such distinguished experts serving on the NASA Advisory Council and available to the Agency during such an exciting time of change. He said, "We take your work and your opinions very seriously, and we are committed to providing you with an Agency response to every recommendation you provide to us." He expressed his best wishes for a successful Council meeting and thanked Council members for taking the time out of their busy schedules to meet and share their knowledge and insights with NASA.

Administrator Bolden then presented the NASA Exceptional Public Service Medal to Dr. Ray Colladay, for his past service as an ex officio member of the NASA Advisory Council, representing the Aeronautics and Space Engineering Board of the National Academies. He said that Dr. Colladay was a friend and colleague who had served the Council with great distinction. Although his tenure on the Council has ended with the end of his tenure as Chair of the ASEP, he looked forward to hearing Dr. Colladay's presentation later that morning on the recently concluded National Research Council study he had chaired to evaluate NASA's Space Technology Roadmaps.

Question and Answer Session with Administrator Bolden:

Mr. Richard Kohrs said NASA had no money for a place to go. Administrator Bolden said exploration was not possible without international cooperation; this was not just to save money but to engage a broad range of talents and capabilities. He had heard talk that NASA was "walking away from Mars." Nothing could be further from the truth. He noted that in its space partnerships,

NASA did not “charge money” – all exchanges were based on quid pro quo. ESA owed NASA considerable money for the ISS; NASA will be compensated in ATVs. Dr. Squyres said the central issue was the need to identify a real destination for exploration, which would energize, motivate, focus and inform the Agency and the public. He thought that when NASA was better able to characterize asteroids, it could identify possible targets for a 2025 human mission. This would excite the public. At present, he noted, when NASA says it will land on an asteroid, people ask: which? It was noted that unless the asteroid was heavier than the spacecraft, “it would start orbiting you.”

Dr. Squyres said the NAC had an unprecedented number of recommendations to make. One was whether the NASA Science Mission Directorate [SMD] budget could be presented as analogous to that of other physical science agencies, which, he noted, had done better in budget terms. He noted that NASA had not been included in “America Competes Act” because it was not considered a science agency. He considered this absurd. Administrator Bolden responded that the Agency presented the President’s Science Advisor with two or three newsworthy items every day; some were delivered to the President. NASA needed to become recognized as a legitimate research and development undertaking. Unlike the National Science Foundation [NSF] which focuses on basic research, NASA had missions. NSF does pass-through funding to researchers and universities. Dr. Squyres offered the NAC’s assistance in the matter. Dr. Smarr noted that when one looked at NASA’s \$8 billion JWST budget wedge, it raised questions of balance among space science programs at NASA.

Administrator Bolden noted there was a continuing Agency discussion regarding Information Technology [IT] and the Mission Directorates concerning where should responsibility lie for IT at NASA. He noted that virtually every researcher wanted to have his or her own information immediately at hand; that could not be afforded. He believed that NASA had cyber-security vulnerabilities due to the distributed nature of its information system. Dr. Smarr said NASA’s data needed an integrated approach. The NASA Office of Chief Technologist and Office of Chief Scientist needed to be a part of this dialogue. Scientists, he added, do not necessarily have the best conception of modern information management approaches and best practices. Administrator Bolden said that when he rejoined the Agency as Administrator several years ago, the emphasis had been on development of NASA’s internal “cloud” data system; however, due to lack of funding or attention, NASA was now dwarfed by the commercially available “cloud” options. A decision was needed. He said that his Chief Technologist and Chief Science were working on a NASA “Big Data Initiative.”

Discussion then turned to JWST, which, unlike Hubble, had not been designed to be serviced. Administrator Bolden was asked whether a grapple attachment should be added to JWST so that astronauts could grab hold and repair/refurbish the spacecraft while in orbit. He was also asked about Lagrange points.

Administrator Bolden noted the earlier conversation that the first commercial cargo launch would come soon; commercial crew was not far behind. That would present a fundamentally different task to the Agency. A NAC member asked: given that NASA is in a time of transition and looking at placing astronauts to low-earth orbit, was the Administrator comfortable that adequate attention was being paid to crew safety? Administrator Bolden said this had been discussed the previous day on Capitol Hill during his Congressional hearings. His answer to that question was “yes.” There were programmatic risks. Mr. Kohrs said that the most important consideration in crew safety was to complete training while the ISS remained in service. Administrator Bolden said NASA had not provided competing companies with requirements; what had occurred was two years of back and forth to determine the human requirements. The commercial companies cannot claim they did not know any requirement when they present their design. He said he did not greatly care where the vehicle came from; the issue was reliable access to space. He added: “We don’t just need launch vehicles; we need destinations.”

Administrator Bolden closed by again expressing his appreciation to the Council members for serving as NASA’s advisors, and for his time spent with the group.

President’s FY 2013 Budget Request for NASA

Ms. Elizabeth Robinson
NASA Chief Financial Officer

Ms. Elizabeth Robinson, NASA Chief Financial Officer, reported on the President’s FY 2013 budget recently submitted to Congress. Her overview statement was: “We have made tough but sustainable choices to provide stability and continuity to existing programs and set an affordable pace for unfolding the next great chapter in exploration.” Ms. Robinson identified the following important considerations:

- In a time of fiscal austerity, NASA accepts the requirement of a flat out-year top-line budget.
- NASA will continue efforts to improve operational efficiency and maintain reduced spending for service contracting, travel, supplies and related areas.
- NASA will align human capital with the Agency’s priority requirement; this will mean a reduced rate of re-hiring in FY 2013.
- NASA will use full-cost accounting, where all project costs are allocated to the project, including funding for the Agency’s civil service workforce.

Ms. Robinson then presented details of the President's FY 2013 budget request, with annual figures through FY 2017. The out-year figures were notional; the plan was a nominally flat budget over that time. Ms. Robinson noted a general effort to shift expenses from administrative categories to programmatic categories. NASA had been directed to reduce the former by \$100 million in FY 2012 and \$200 million in FY 2013. She said NASA's civil service workforce needed to be aligned with actual program requirements. NASA had experienced a record number of retirements in the past year, owing to the Space Shuttle closeout and employee buyouts. It was uncertain how many would be hired to replace those departing. Ms. Robinson presented the full roster of NASA launches pending through 2019. She noted, regarding Earth Science missions, the budgetary philosophy had been not to disturb those missions scheduled prior to 2016; delays of missions already in development generally had major cost consequences.

Ms. Robinson then turned to Planetary Science, which was incurring a \$300 million reduction, most of which fell on four missions. The budget continued work on the Lunar Atmosphere and Dust Environment Explorer [LADEE] and the Mars Atmosphere and Volatile Evolution [MAVEN] launches in FY 2013. In general, she said, to the extent resources permitted, the Planetary Science budget followed the National Research Council's Decadal Survey. Missions in progress were not being reduced; future missions were.

Dr. Ballhaus asked if anyone was tasked with identifying NASA core competencies and how to maintain them. Ms. Robinson said this was being looked at broadly; the highest priority was entry, descent and landing [EDL] onto the Martian surface. Dr. Ballhaus noted that several world-class capabilities could be lost in a few years time if the missions requiring them went unfunded. Responding to a query, Ms. Robinson said a "medium class" mission generally had a budget between \$500 million to \$1 billion, exclusive of launch vehicle. She noted the proposed FY 2013 budget continued the restart activities on Plutonium-238.

Regarding Astrophysics, Ms. Robinson said the proposed budget emphasized small missions; this would include an Explorer mission in Astrophysics and another in Heliophysics. Addressing the James Webb Space Telescope (JWST), Ms. Robinson said the FY 2013 budget contained no real changes. The Heliophysics budget included funds to complete formulation and undertake initial development of the Solar Orbiter mission, in cooperation with ESA. She thought this was important to know, as many people believed NASA's only collaboration with ESA WAS on Mars-based activities.

Ms. Robinson then noted that several years ago NASA had established the Joint Agency Satellite Division [JASD] to manage the satellite work NASA did for other agencies. These included, for the National Oceanic and Atmospheric Administration [NOAA], elements of the Joint Polar Satellite System [JPSS]; Geostationary Operational Environmental Satellite-R [GOES-R] series; Jason-3; and Deep Space Climate Observatory [DSCOVR] satellite. She thought it possible that the next LANDSAT mission might start development, but at present the budget was not available.

Turning to Aeronautics, Ms. Robinson noted it had received an \$18 million cut, mostly in hypersonics. NASA would continue to maintain emphasis on NextGen aviation activities. Ms. Robinson then reported that Space Technology had received increased funding. This did not reflect any new programmatic activities, but followed from the natural curve of approved activities, several of which were moving into their high-expense periods. Ms. Robinson reported that all Construction accounts had been consolidated, thus accounting for that area's increase.

Ms. Robinson then reported on Exploration Systems Development, which included development of a heavy-lift launch vehicle [for which \$1.88 billion was appropriated for FY 2013]; corresponding modifications for the Kennedy Space Center; and development of the Orion Multi-Purpose Crew Vehicle [for which \$1 billion was appropriated for FY 2013]. She noted that the Agency continued to develop U.S. commercial systems that would reduce dependence on Russian spacecraft for reaching the ISS. Dr. Squyres said he believed selection had narrowed to a few potential suppliers. Ms. Robinson said she anticipated selection being made this summer. Responding to a query, Ms. Robinson said U.S. crewed vehicles were expected by 2017, though several potential applicants believed they could achieve this goal sooner.

Ms. Robinson then turned to the Space Shuttle. She noted Shuttle phase-out was costing NASA \$500 million. Thousands of pieces of the Space Shuttles had to be disposed of; those that had been in space would need to be irradiated, not just the orbiters, but a number of other hardware items.

Ms. Robinson noted that for Education, the budget had been reduced from a former high of \$180 million to \$100 million. This was the sum NASA had for direct work with universities and schools. Responding to a query, Ms. Robinson said the budget for Space Grant had been reduced from \$40 million to \$24 million. She noted that cross-agency support and construction had received an increase, including \$60 million for environmental compliance. Infrastructure investment would be directed at reducing operating costs, beginning with KSC and JSC.

Mr. Richard Kohrs noted that full-cost accounting had been removed, and then reinstituted to include civil servants. Ms. Robinson said that was correct. When full-cost accounting was originally established at NASA, all civil servants were allocated

out of project funds for all codes. Since 2004, this approach has been “progressively undone.” This, she noted, created great budgeting problems, as no two years were strictly comparable. With the transition of the Space Shuttle, it was deemed very difficult to fund all civil servants from one place at the same time. The NASA union, she said, urged creation of a unified labor account; she had supported this. By late 2010, “we were ready to go forward” when Ms. Robinson received a call from Capitol Hill saying it could not be done. The unified budget, she was told, would make NASA civil servants “apparent” to Republicans in Congress, who wanted to reduce their number. Ms. Robinson said she informed the caller that NASA had already formatted its budget based on a unified labor account. She attempted to persuade Congress of the wisdom of such a move, but was told that Congress would not go along: full-cost accounting was required. This brought things back to square one. Nonetheless, she felt far more flexibility existed than many thought. People would say: “We can’t do education because we lack a budget code for education.” Ms. Robinson termed this ridiculous. If the Agency declared education part of its overall mission, then no separate bookkeeping was required. It sometimes seemed, she said, that each of NASA’s 18,300 employees had to be told individually that they had flexibility. Dr. Ballhaus said that when he worked in industry, everything was full-cost accounting. Its use in an organization like NASA resulted in researchers spending half their time writing proposals. Ms. Robinson commented that while this was commonly believed, such use of time was not a consequence of full-cost accounting. Rather, it followed from handling science proposals competitively. She believed the Centers and programs needed to discuss how labor costs were assigned; such talks were beginning to happen.

Ms. Robinson was then asked the question of who was responsible for maintaining scientific and technological competency. She responded that NASA researchers may be at a disadvantage with university researchers in securing competitive awards because their tasks were different. She noted that within NASA, anybody working on a proposal could be funded somewhere; the harder issue was how much time a researcher had for what he or she wished to work on. Dr. Ballhaus noted that because of the presence of civil servants, NASA could not adjust its skill mix as fluidly as in the commercial world. Mr. Kohrs asked what NASA’s attrition rate was. Ms. Robinson said generally two to three percent. Half of these were buyouts. A question was asked concerning the impact of a sequestration of funds at NASA. Ms. Robinson said the Agency’s view was that “Congress will do the right thing.” If sequestration occurred, cuts had to be across the board. For NASA, a reduction of \$1.2 billion was likely. NASA would not be permitted to undertake a Reduction in Force [RIF]. She noted, as a related matter, that if the Agency broke the “limitations of funds” clause, it could be “sued by just about everybody.”

Dr. Squyres said he thought the proposed NASA budget for FY 2013 contained much good news. He asked Ms. Robinson what her largest concerns were. Ms. Robinson said the commercial effort to create an alternative space transportation system to the ISS was a major concern; if the necessary funding was not made available, the 2017 target would not be met. More generally, she said, NASA had “a lot on its plate.” There was no margin if any given project experienced financial trouble. Another area of concern was space technology: the Agency was trying to push the frontier. In practical terms, this was where core competencies were secured; any project cancellation would reduce competency.

Dr. Squyres thanked Ms. Robinson for her presentation.

Council Discussion

Dr. Steven Squyres asked Council members, having heard about the proposed FY 2013 budget from the Obama Administration and NASA’s Chief Financial Officer, what they thought? Dr. Boss expressed “consternation” at the cuts in what many regarded as a very successful Planetary Science Program. Could this be remedied? Perhaps the Science Mission Directorate [SMD] should be presented as a science agency located inside a mission agency. Perhaps decision-makers should be asked if they really intended this. Dr. Squyres said the NAC had to operate within its constraints; noting that they were Special Government Employees. Ms. Smith identified ongoing tension between what NASA was capable of doing and what others wanted NASA to do. NASA continued to try to be all things it had ever been, and on a reduced budget. That was not going to work. The question, she thought, was how NASA identified and made good on its key functions. The primary mission of NASA was as an active space exploration agency; this needed to be clear to the public. The end of the Space Shuttle program is perceived as the end of NASA; this is not correct, and Ms. Smith thought the NAC might be able to help with this misperception. As an example, she noted that she had attended the final Space Shuttle launch last year, and her five-year old nephew had been in awe. However, she overheard many people nearby expressing that their sadness and distress that the Shuttle program had ended, and that there would be no further launches. A teenager in the throng had also overheard this, and jumped in by saying, “Get over it! Don’t you think NASA can do something better than that in the future?” Mr. Perkins expressed total agreement with Ms. Smith. NASA, he said, had over-publicized the Space Shuttle and under-publicized the ISS. Astronauts have been orbiting in the ISS for a dozen years. Everyone should have the ISS with the Earth in the background as a screen saver on their computers. JWST does not occur until 2018; the ISS was the one thing we have to talk about now.

Mr. Hanisee asked how much money would be spent developing commercial flight. He thought perhaps six flights would occur. What happened thereafter? Bigelow, he added, talked of 12 flights over three years. Mr. Hanisee said thought needed to be directed to the capability the commercial groups were creating. Mr. Kohrs said he believed the Space Shuttle could have been readily extended to 2015 or 2020; and with some difficulty to 2025. Mr. Hanisee said two companies were being funded so crews could be shuttled back and forth; he doubted they would make back their money. Dr. Squyres noted that the cuts to

NASA's Planetary Science Division threatened core competencies. Timing the availability of commercial crew was likely to create budget pressure. One NAC member noted the President's proposed budget did not provide funding for any vehicle capable of more than a 21-day mission. This limitation tied to the absence of a destination, which, in turn, tied to the lack of clarity about NASA's intentions. Dr. Ballhaus said NASA took on too much; partly, this was due to political pressure. If JWST and the Mars Science Laboratory rover were properly formulated, an adequate reserve would allow them to be done. He added that some in Congress did not understand the need for reserves in NASA's space missions.

Mr. Hanisee raised a question about NAC scheduling. He said the Council has been meeting four times a year. Dr. Squyres noted that the traditional four annual Council meetings had been reduced to three in 2012. NAC committees would meet on an as-needed basis. Dr. Smarr noted that commercial computing infrastructure has become vastly larger than NASA's. Google, he said, employed 20,000 topnotch software engineers; how many did NASA have? NASA, he added, still believed it would develop "all this stuff." NASA, he added, should adopt a policy of partnering with other agencies and public/private partnerships. Dr. Squyres suggested the Council consider what conversations this might require.

NRC Study on NASA Space Technology Roadmaps: Final Report

Dr. Ray Colladay, Former Chair
Aeronautics and Space Engineering Board
National Research Council [NRC]

Dr. Ray Colladay opened by providing some context. He said his NRC study committee did not believe it was sufficient to ensure that technologies existed as needed for all currently intended missions. NASA's technology base was depleted; a sense of urgency was at hand. He noted that, frequently, short-term budget restrictions forced delays in technology development. Sooner or later the price had to be paid. His committee had therefore looked to create roadmaps that would provide stability, structure and direction. Dr. Colladay noted that the Office of Management and Budget [OMB] held that Aeronautics already had a roadmap; therefore, it had not been included. His group focused on the next 20 to 30 years, anticipating that interim reviews would come every five years. He noted that the 14 roadmaps included 320 technologies at Technology Readiness Level [TRL] 3. He stressed that his NRC study committee was not making a critique; it was making decisions. He then provided the structure of the technology breakdown and identified the panels, the steering committee members, the staff and the schedule.

Dr. Colladay said the study was extended to include the National Academy of Science to move it outside of a 'NASA-centric' context. A public meeting was held on each roadmap. Initially, he had intended to identify five key technologies for each roadmap. He was not entirely successful in this, as some groups had eight or more selections. Dr. Colladay said a pivotal question was: what are the large things that require focus? This, he said, encouraged the group to look across the Agency's mission set. Dr. Colladay commented that importance and affordability were balanced. He noted the group was "biased toward game-changing capabilities." Further, while the group focused on NASA needs, it paid attention to Aerospace and other national goals. Dr. Colladay then addressed the question of sequence and timing. There were many "great ideas," but what was the appropriate sequence? One question posed to proponents was: if we gave you \$10 million, how would you spend it? Often, he noted, people had no idea where they would start. He noted that various people had urged deferring technology investment until "we [NASA] know where we are going." That argument could be reserved. Technology established the parameters of what was possible and, therefore, what missions could be undertaken. Dr. Colladay presented information on the weighted scores for a variety of possible technology developments. He noted, however, that his committee had not felt bound by the scores: "If something simply didn't make sense, we overrode it." Dr. Colladay focused on the area of launch propulsion. Mr. Kohrs noted that the group did not designate a type of propulsion. Dr. Colladay said this was true; the group was dealing with both high priority challenges and high priority technologies. The former was needed to get a grip on the latter. The final report ran 450 pages, including appendices, and reduced the number of possible technology developments from 295 to 83. Dr. Colladay outlined the committee's deliberative process, which consisted of the following: integrate individual rankings, analyze distribution, identify gaps, challenge exceptions, truncate. The full cycle was repeated three times. Each time, possibilities were cut from the bottom of the list. Dr. Colladay said the group worked to three technological objectives; these being:

- Extend and sustain human activities beyond Earth orbit.
- Explore the evolution of the solar system and the potential for life elsewhere [*in situ* measurements].
- Expend our understanding of Earth and the universe in which we live [*remote* measurements].

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Dr. Colladay stated that one basic assumption had been that NASA would continue to pursue a balanced space program that spanned human exploration, space science, space operations, space technology, and aeronautics. Therefore, since the technology program should broadly support the breadth of Agency missions, the NRC committee established priorities in each of the three technology objective areas independently. Showing the results of the process, Dr. Colladay noted that "improved access to space" was the highest priority in each category. He then identified the challenges to achieving the highest priorities. He noted that fission power was a "big ticket" item and might rapidly be priced out of the intended range; on the other hand, the development of nuclear power would fundamentally change the exploration of the universe. He noted that no one wished to state that nuclear power was a requirement, and, he added, NASA engineering had shown itself quite skilled at working around technological gaps. Still, at some point NASA was going to have to "bite the bullet" and address fission power generation. He

noted that some technologies were grouped together because their solutions appeared to be related. Mr. Colladay then presented the 16 technologies in the final prioritization and, in succeeding slides, how each related to the three key challenges described above. He then distinguished between the relevance each had for national vs. commercial needs. If, he said, the entire exercise was somewhat speculative, then the judgments about national vs. commercial needs were “speculative squared.” Dr. Colladay was asked if there was an appropriate level of investment that NASA should make in technology. He said it was a question more easily answered in private industry. His “off the cuff” view was that NASA should devote 10 percent of its resources to technology, and 10 percent of that total to “seed corn” technologies [TRL-1 and TRL-2]. He observed that in general it was easier to start things than to stop them. When working in private industry, he had made it a ground rule to roll over 30 percent of the program each year. Emphasis, he said, needed to go to stopping as well as starting. His NRC group made the following recommendations:

Recommendation: Technology Development Priorities

- 16 identified high-priority technologies
- Associated top technical challenges
- Modest but significant investment in low-TRL technology (10%)
- Flight demonstrations (high TRL with cost share)

Dr. Colladay commented that cooperative development was necessary because no one individually had sufficient funds.

Recommendation: Systems Analysis

- Disciplined system analysis for management of the space technology portfolio
- Improve systems analysis and modeling tools, if necessary

Recommendation: Managing the Progression of Technologies to Higher TRLs

- Rigorous process to down select
- Only most promising technologies proceed

Recommendation: Foundational Technology Base

- Discipline-oriented technology base program
- Evolutionary and revolutionary advances
- Expertise of NASA, other departments, industry, and academia

Recommendation: Cooperative Development of New Technologies

- Cooperative development with other organizations to leverage resources

Recommendation: Flight Demonstrations and Technology Transition

- Office of Chief Technologist [OCT] collaboration with mission offices and outside partners for flight demonstrations
- Document collaborative arrangements
- Two recommended flight demonstrations:
 - Cryogenic Storage and Handling
 - Advanced Stirling Radioisotope Generator Technology

Dr. Colladay noted that the last two items were at “the tipping point.” To these recommendations, the following findings were added. First, production of Plutonium-238 [Pu-238] was essential for deep space missions. Dr. Colladay noted that every NRC report in the past decade urged restarting of Pu-238 production. Second, program stability was uncertain. Dr. Colladay said, “We don’t lack stability because of a lack of progress. The threat to stability is the result of the politically-induced churning.”

Recommendation: Industry Access to NASA Data

- Make NASA technical data more readily available to U.S. industry
- Particularly for companies not working with NASA
- Archive data in a readily accessible format

Dr. Colladay said that some people found NASA difficult to work with, believing important data was being withheld.

Recommendation: NASA Investments in Commercial Space Technology

- Focus on technologies supporting NASA mission needs,
- Collaborate with the U.S. commercial space industry for industries needs (precompetitive technologies), similar to aeronautics

Dr. Colladay commented that NASA should focus its technology on supporting NASA mission needs, and collaborate with the U.S. commercial space industry for needs similar to aeronautics.

- *Finding and Recommendation: Crosscutting Technologies*
- *Review / expand roadmap sections on crosscutting technologies*
 - *Avionics*
 - *Space weather beyond radiation effects*
 - *Others*
- *Assure effective ownership for crosscutting technologies*
- *Many technologies cut across multiple roadmaps*
- *Coordinated development of high-priority crosscutting technologies*

Dr. Colladay noted that NASA had received his report only four weeks previously. He said the response to date was pleasing. He suggested that a timeout occur during which period NASA could undertake further work without having too many people looking over their shoulder. Dr. Squyres asked what NASA spent Agency-wide for technology. Dr. Ballhaus said that as such funds were scattered around, it was difficult to know. Dr. Smarr said there was a tradeoff between higher risk vs. game changing technologies. To be able to get to Mars in a month is a game-changer. Dr. Colladay said “this is all baked in.” He added that some scores jumped off the page, such as fission power and nanotechnology. He asked if it might be possible to protect astronauts by magnetic field. He noted that the group had been extremely receptive to ideas, but in all cases had “pushed back” to ask advocates what they would do if they actually had the money. He believed fusion power was a classic example of this. An audience member asked what engagement had taken place with persons in Aeronautics. Dr. Colladay said panels had been repeatedly directed to talk to Aeronautics; Aeronautics had been very much part of the discussion. If, he said, he were king for a day, he would merge aeronautics and space technology. Dr. Squyres told Dr. Colladay that his group had done a fantastic job, given the magnitude of the task. He in particular appreciated the hard-nosed, pragmatic approach taken.

Human Exploration and Operations Committee Report

Mr. Richard Kohrs, Chair

Mr. Richard Kohrs noted that the previously-existing NAC Space Operations Committee and NAC Exploration Committee had been combined into the Human Exploration and Operations Committee, which had met for the first time on October 31-November 1, 2011, and, subsequently on March 6-7, 2012. He presented the agenda for the recent committee meeting and Mr. Kohrs presented the organization chart for newly-created NASA Human Exploration and Operations Mission Directorate [HEOMD]. He noted that a new organization, Space Life and Physical Sciences Research and Applications, had been created within HEOMD. His committee had received detailed briefing on HEOMD activities on November 1, 2011. He added that his committee would be making a recommendation pertinent to this organization.

Addressing the budget, Mr. Kohrs said that given the expenditures on the Orion Multi-Purpose Crew Vehicle [MPCV] and the Space Launch System [SLS] through FY 2017, there was no money in the Exploration budget to build anything else. He believed greater efforts needed to be made at promoting international cooperation. A “big rocket” was being built but had no place to go. He noted that funding for the Space Technology Program had been moved to the Office of Chief Technologist. Dr. Ballhaus said there was a priority need to “get one’s arms around all the technology NASA had or was developing and make assessments as to what was working.” Mr. Kohrs said the effort would be made to have management of all TRL-1 and TRL-2 done by “about 30” people from NASA Headquarters. He believed this a very large task. Dr. Ballhaus commented that, generally, NASA Headquarters does not have the skills that Centers have. Mr. Kohrs said the general approach is to delegate down; he added that he hoped it worked because it would save considerable time and money. He added that he was aware that a lot of people were adopting a wait and see attitude.

Mr. Kohrs turned next to the subject of SLS. Dr. Squyres asked if the SLS was going to acquire a name that might convey a crisper message of the public. Mr. Kohrs said he had never heard it called anything else. Mr. Kohrs commented on the status of the Orion MPCV, noting that most recent drop tests had been conducted on February 29, 2012, on the vehicle entry, descent and landing [EDL] parachutes. He noted that construction of MPCV was occurring at various sites, the final installation would be done at the old Cape Kennedy site. Mr. Kohrs presented five different configurations for the SLS, which would weigh in range of 130 metric tons. Mr. Kohrs then presented the overall test strategy for SLS, noting that flights are needed to test critical mission events and demonstrate performance in relevant environments. Data collected would be used to eliminate SLS flight tests as the SLS configuration became better determined. He added that four missions/test flights were planned to meet minimum mission/flight test. The first of these, in 2014, would be of an uncrewed vehicle and would be aimed at systems testing and risk reduction. This Engineering Mission-1 [EM-1] flight would probably achieve 80 percent of the re-entry heat, by having the spacecraft do an additional “burn” while accelerating back to Earth. The first flight, he added, would not have abort capability. Mr. Kohrs added that his committee questioned whether the EM-2 flight was justified. Its mission – to travel near the Moon for three to seven days – had been done 40 years ago; he questioned placing a crew in jeopardy to repeat something already accomplished.

Mr. Kohrs then reported on Advanced Exploration Systems [AES], which, he said, were building the key capabilities needed to enable human and robotic exploration. These included Deep Space Habitation Capability; Crew Mobility Capability; Crew-

Centered Operations Capability, and Robotic Precursors Capability: Enable robotic precursor missions to characterize potential destinations for human exploration. Outlining the timeline for these activities, Mr. Kohrs said they would proceed until 2014-2015, at which time a point of focus would be selected for each category. Mr. Kohrs then described the AES Pioneers program, which he described as a “skunkworks” effort aimed at rapid development of prototypes. Among other activities, he noted that the NASA Tournament Lab sponsored competitions to engage the public in developing software needed by NASA projects. Those participating included high school students; if their product worked, they were paid up to \$750. He noted that AES projects were proceeding in 20 areas – in one, logistics, and an effort was underway to create trash compactors that could take packaging and turn it into wall insulation. What he liked about the effort was that it encouraged workers to get back into the labs and produce something that may eventually pay off for the Agency. Mr. Kohrs presented his committee’s first recommendation:

Recommendation: Select a human spaceflight destination ASAP.

Dr. Squyres termed this recommendation a “winner.” Mr. Kohrs said this had been a problem for 25 years. Dr. Squyres said this question was fundamental to a host of Agency issues – morale, not the least. Dr. Smarr noted that the current nominal target was an asteroid, but he did not feel that was in his committee’s mind. The Council approved this recommendation.

Mr. Kohrs presented his committee’s second recommendation:

Recommendation: Develop specific mission objectives for Exploration Mission - 2 (EM-2) that justify the need for a crewed lunar orbit mission.

Mr. Kohrs noted that selecting a destination had implications on hardware. Ms. Smith said the question was what was doable in the current environment. Several Council members commented that at present the EM-2 mission lacked justification. Dr. Squyres asked whether the group opposed the mission or preferred doing it in Low Earth Orbit [LEO]. He might feel differently, he added, if a definable objective was attached to the effort. Mr. Kohrs said he worked on Constellation without any clear idea of how it was to be deployed; he believed that \$1 billion could be spent to duplicate EM-2 at some later date. The Council approved this recommendation.

Mr. Kohrs presented his committee’s third recommendation:

Recommendation: Take advantage of existing ISS international partnerships to accelerate expansion of international participation in future deep-space exploration planning. This expanded partnership will bring international resources to exploration and enhance sustainability.

Dr. Steven Squyres asked if this was an indirect way of saying that NASA should find an international partner who has “the missing piece.” Mr. Kohrs responded yes. Dr. Squyres said he thought the intent was excellent, but asked if clearer wording could be employed. He would prefer straightforward statement that the implementation of Recommendation #1 required Recommendation #3. Mr. Hanisee commented that to the extent highly specialized missions led to customization of hardware, they tended to narrow the range of possibilities. Dr. Squyres said that Mr. Hanisee’s point would be pertinent once a goal had been determined. Dr. Squyres asked Mr. Kohrs to provide a reworded version of the recommendation for consideration by the Council on the following day, to which Mr. Kohrs agreed.

Mr. Kohrs presented his committee’s fourth recommendation:

Recommendation: The HEO Committee recommends that NASA modify the proposed fixed price Integrated Design Contract (IDC) to a more conventional Contract mechanism such as Cost plus Incentive Fee.

Ms. Smith stated she was not in favor of this recommendation; NASA could not continue to use cost-plus contracts. Mr. Hanisee said he thought fixed-price would be a disaster both for the Agency and for the contractors; if one told a contractor that if the contractor got in a financial bind, NASA would bail it out, you did not have fixed-price contracts. Dr. Ballhaus said that fixed-price contracts made no sense during the development phase; he considered it a prescription for disaster. It allowed a contractor to “drive up a truck; dump something; and say: this is your product.” Dr. Squyres, as Council Chair, noted the absence of consensus and said further Council discussion would occur the following day.

Mr. Kohrs presented his committee’s fifth recommendation:

Recommendation: The NAC HEO Committee recommends the creation of a subcommittee of the HEO Committee that advises NASA on the research and educational needs that are required to support a plan for the long-range human exploration of space. The subcommittee should include a breadth of perspectives that encompass research and higher educational needs, not representation of specific disciplines.

Mr. Kohrs said Mr. William Gerstenmaier, NASA Associate Administrator for Human Exploration and Operations, was “on the fence” on this recommendation, nonetheless, the committee thought it wise to have the option. Dr. Squyres said he had no intention of micromanaging the NAC and would not “shoot down” a committee’s idea. The Council approved this recommendation.

In sum, Recommendations 1, 2 and 5 were approved; 3 awaited new wording; 4 awaited additional discussion.

Commercial Space Committee Report

Ms. Patti Grace Smith, Chair

Ms. Patti Grace Smith provided some general background on her committee, and noted she planned to leave two committee seats vacant for the foreseeable future so as to permit a reorientation of the committee’s task. Her committee’s charge, she said, was to look at NASA writ large, particularly in terms of the Centers and new commercial undertakings. She felt there were disconnects between the voice of NASA Headquarters and the voice of the Centers – how could these be knit together? She noted that her committee would be receiving briefings from seven of the ten Center Directors on various Center-level activities. There was a measure of tension, she said, at Centers that had their own legal staffs but still had to pass things through NASA Headquarters, which was time consuming. One question to be addressed, she said, was how skilled was NASA at importing from industry things that industry had found easy ways to do. The view of NASA Associate Administrator for Human Exploration and Operations, Mr. Bill Gerstenmaier, which she shared, was that NASA needed to become far more active in this area. Ms. Smith presented her committee’s meeting schedule, with future meetings set for April 2012, July 2012, September 2012, and November 2012. The September meeting would include a mapping activity that would allow the committee to ready its thinking for delivery to NASA. She reported on the “key takeaways” from her two committee meetings of December 9, 2011 and February 22-23, 2012. Ms. Smith then presented a list of “emerging themes and future topics,” noting that any of these may evolve into committee recommendations in the future.

- The need to improve the processes and authorities for establishing agreements between the NASA Centers and commercial industry.
- There are many opportunities for commercial space partnerships at the NASA Centers, but they may not be as well known as they should be.

The Committee is currently assessing candidate topics to pursue, which can result in meaningful and timely advice to the Agency. Some were suggested by NASA senior leadership. Potential topics include but are not limited to:

- Commercial Crew’s certification phase
- “What should commercial space look like in 30 years?” and how to enable it
- Indemnification in a commercial space environment
- Commercial industry perspectives on Federal Acquisition Regulation [FAR]-based contracts’ requirements and restrictions
- Agency culture change
- Agency infrastructure, and excess capacity from a commercial space perspective
- Other NASA areas that could present opportunities for commercialization
- National Polar-orbiting Operational Environmental Satellite System [NPOESS]/Joint Polar Satellite System [JPSS]
- NASA/Federal Aviation Administration [FAA] interfaces and potential partnerships

Ms. Smith said she felt risk-sharing was insufficiently understood. Mr. Kohrs asked if range safety was involved with launch. Ms. Smith said it was. Mr. Kohrs added one had to get range safety approval in addition to NASA and FAA approval. Ms. Smith said she had never had an application for range safety approval returned. She closed by noting that her committee had no findings or recommendations to make at this time.

Education and Public Outreach Committee Report

Mr. Lars Perkins, Chair

Mr. Lars Perkins presented the committee’s membership. Dr. Squyres suggested that if Mr. Perkins believed his committee needed additional personnel, he would assist. Mr. Perkins listed his committee’s activities to date, including:

- September 8, 2011: Education brainstorming session at the NASA Jet Propulsion Laboratory. This event included identifying ways to use pop culture figures in a back-to-school show on robotics, NASA, and vehicle launches. A song, “*Reach for the Stars*,” had been composed and the participation of will.i.am, a member of the music group, Black Eyed Peas, which had appeared at the 2011 Super Bowl, had been obtained.
- November 26, 2011: Mars Science Laboratory launch event.
- December 9, 2011: A NASA Future Forum held in Seattle and hosted by Doug King, a member of the committee.

Mr. Perkins said that NASA faced “the taxi driver problem.” That is, if you told a cab driver you worked with NASA, the likely reply was: “NASA? Are they still in business?” There was a false equation; namely, that “NASA equals Space Shuttle.” Mr. Perkins emphasized that NASA’s message to the public has to be strategic and repeated often. “You have to say what you do, over and over again.” He noted in the late 1960s at the height of the Apollo era, NASA’s received 4.4 percent of the Federal budget. Today, it was only 0.5 percent of the Federal budget. He observed that because the American people commonly had high expectations for NASA, they also thought it must have a huge budget. Regarding budget, Mr. Perkins said while NASA spent \$100 million annually on education; the central budget for public outreach was only \$5.8 million; the latter under the direction of Mr. David Weaver, NASA Associate Administrator for Communications. However, total Agency-wide expenditures on public outreach (including but beyond the Office of Communications) was unknown, but might reach \$500 million. He noted that public outreach at NASA was very dispersed; each of NASA’s 10 Center Directors wished to handle publicity efforts for that Center. As a consequence, there was no consistency of Agency message or emphasis. It was as though Coca-Cola was variously advertised for its cans, its sugar, its ink, its carbonation, etc. NASA must speak with one voice. He did not believe it was a matter of engaging in “marketing” NASA. Rather, the country is in educational crisis; the U.S. lacks scientists and engineers. NASA inspires and NASA innovation drives global competitiveness and economic growth. He quoted a 1962 John F. Kennedy statement about NASA: “Space is there, and we’re going to climb it, and the moon and the planets are there, and new hopes for knowledge and peace are there.” This is “an act of faith and vision, for we do not now know what benefits await us.” Mr. Perkins noted the www.nasa.gov website set a record in 2011 with 150 million visits; that 562,000 people had watched the launch of the STS-135 mission live on NASA.gov; that a NASA web team has released its first app, a Facebook game called “Space Race Blast Off.” People, he said, want news. They want to be engaged and excited, and they look to NASA for that excitement. He noted that his committee had no formal recommendation to make at this time, but would formulate several for the next Council meeting.

Mr. Perkins presented what in his view should be promoted as NASA’s vision, mission, vision and strategy:

- Vision: “To reach for new heights and reveal the unknown so that what we do and learn with benefit all humankind.”
- Mission: “To lead America’s space exploration efforts ever farther into the heavens, both robotically and with human explorers, including helping humanity spread beyond the confines of the Earth.”
- Strategy: “Decadal goals that can be accomplished within administrative and budgetary constraints, and that are beneficial and inspirational to the American taxpayer.”

He noted that the NASA Education budget included mandated items, such as Space Grant, EPSCoR [Experimental Program to Stimulate Competitive Research, a cross-agency initiative to invest in innovative technology], and MUREP [Minority University Research and Education Programs]. To the extent that Congress increased funding for these programs, it reduced funding that lay within NASA’s discretion. Mr. Perkins presented a summary of Federal support for STEM [Science, Technology, Engineering and Mathematics] education, which totaled \$2.951 billion from 13 different agencies. He stated, “We are not reaching high school and junior high students.” Mr. Perkins presented the STEM Education Framework, a pyramid with steps of “inspire, engage, educate, employ.” He noted that it had taken him four years to learn what all the Centers were doing in education. His advice to NASA, he said, would be to, “use more wood and fewer arrows.”

Dr. Ballhaus asked how much of the \$100 million NASA education budget was directed at K-12. Mr. Perkins said he did not know. He observed, however, that education efforts needed a clear statement of those things that are uniquely done by NASA. He believed there was a shortage of metrics. NASA says, “If we get kids excited about science, more will go into the field,” but empirical evidence was lacking. Mr. Perkins again emphasized the need for a coordinated strategic approach to Agency messaging, stating that the public should have “only one to three” NASA messages to interpret, not 30 to 50. Dr. Squyres suggested the NAC could assist NASA by crafting a clear, crisp message for the public and stakeholders. He noted the need to coordinate NASA’s education and public outreach efforts. He was also aware, he said, that many scientists want as little NASA oversight as possible. It was noted that NASA’s Kepler mission did its own press releases. Mr. Perkins said he believed that few people knew much about Kepler. The problem was not one of writing better press releases, but of having a better Agency strategic message. Dr. Ballhaus noted that the U.S. Space Foundation had worked for years to train teachers; perhaps this group should be contacted. Ms. Smith noted that the Discovery Channel had a range of programs than might be suitable for NASA topics.

Science Committee Report

Dr. Alan Boss

Carnegie Institution of Washington

[Dr. Boss was substituting for Science Committee Chair Dr. Wesley Huntress, who had taken ill.] Dr. Alan Boss said his presentation would consist of reports on science results, programmatic status and findings and recommendations, or, as he summarized the sequence: “The good, the bad, and the seemingly ugly.”

Regarding science, the best news was that the James Webb Space Telescope [JWST] was on track, in line with the replanning and the support it had received from the Obama Administration and Congress. The Nobel Prize in Physics had been awarded to three researchers whose discovery of expansion of the universe was based in part on data from the Hubble Space Telescope. He reported on the Kepler mission. Its first several months of observations produced 312 candidates of Earth-sized planets, nearly as many as 15 years of ground observation. Researchers most hoped to find an Earth-sized planet with a 365-day orbit. Two additional months of Kepler data raised the candidates to 1,235; two further months brought the total to 2,326. Increasingly, he said, Earth-sized planets were being identified. He noted that GRAIL had gone into lunar orbit the day after Christmas 2011. The existence of liquid water on Mars had been confirmed. Images from the Newton Crater taken by the Mars Reconnaissance Observer [MRO] had provided really persuasive evidence. Dr. Boss noted the June 2011 launch of NASA's Aquarius spacecraft in cooperation with Argentina, is monitoring salinity in the upper ocean, important data for determining circulation patterns. He noted that Jason 1 and 2 were providing evidence of sea surface rise of an inch per decade: this could result from ice melt or expansion of warming water. He discussed the role of the Tropical Rainfall Measuring Mission [TRMM] and GRACE in oceanic research. He expressed the view that it was "neat" to see these multiple spacecraft operated in conjunction. Dr. Boss noted that the most intense solar storm in five years had occurred; as solar wind traveled at 400 km/second, the Earth had a four-day warning of its impact. Turning to budgetary matters, Dr. Boss identified "winner and losers." The former included JWST, with \$109 million in additional funding; Earth Science, with a \$24 million increase. Astrophysics had received a \$13 million cut. The major "loser" was Planetary Science, which had lost \$309 million, more than 20 percent. Mr. Robert Hanisee asked if these figures were consistent with budgets presented earlier by Ms. Elizabeth Robinson. Dr. Boss said they were.

Dr. Boss said the Earth Science budget was pretty much the same; changes had been prompted by launch failures, whose cause was uncertain. As this was the second failure with the Taurus XL launch vehicle, it was being dropped from use. Dr. Boss said the Heliophysics budget was pretty flat; it was unclear what would happen with the prospective flagship mission, Solar Probe, as NASA was waiting on the decadal survey for Heliophysics, due in the near future. Dr. Boss noted the "longstanding problem" of replacements for the Delta 2 launch vehicle. The line was reopened, but currently required one to launch from Vandenberg with a polar orbit. Dr. Ballhaus asked why. Dr. Boss noted the launch pad at KSC had been closed. Dr. Boss noted that when the Astrophysics decadal survey was released last year, considerably greater funds had been anticipated. In fact, until JWST was launched, nothing substantial could be undertaken. For the moment, little was happening in technological development for Wide-Field InfraRed Survey Telescope [WFIRST]. He noted that NASA had dropped out of the Euclid project because of its budget problems; then, following much consultation, had decided NASA should have some sort of participation, perhaps through supplying hardware to ESA.

Dr. Boss said "the really ugly one" was Planetary Science, which had been expecting an increase. The \$300 million decrease coupled with the loss of the expected \$200 million increase meant that NASA's Planetary Science Division was receiving \$500 million less than anticipated. He quoted Dr. Wesley Huntress who said he had never seen a single program take so large a cut. As a consequence, NASA had withdrawn from the 2016/2018 ExoMars missions that had been formulated with ESA. NASA remained committed to the search for life on Mars. On other matters, he noted the Discovery Program launch rate had been reduced; the Near Earth Object program had been expanded; and that the rest of the Planetary Science Program was "in pretty good shape." Dr. Boss summarized the programmatic impacts as follows: The next Discovery Program Announcement of Opportunity would be released in 54 months rather than the 24 months recommended in the decadal survey; there were no missions pending to the Outer Planets. At some point, Cassini will de-orbit. It is unclear whether NASA will participate in the Europa mission.

The NAC Science Committee, he said, had one finding and four recommendations. The finding was:

NASA's top line in the Administration's FY 2013 budget proposal is nearly the same as in FY 2012 (down \$58.6M or -0.3%). The FY 2013 budget establishes JWST as an agency priority and provides in full the resources identified in last year's re-plan to complete JWST and launch it in 2018. Earth Science is also increased in FY 2013 and the out-years.

The overall SMD budget has been decreased by \$162.5M (-3.3%) in FY 2013 and is flat-lined for the 5-year run-out. This funding is a proportionally much larger (11-fold) decrease for SMD compared to the entire Agency. Many recommendations in the recent NRC Decadal Surveys will not be accomplished, particularly Flagship-class missions in Planetary (Mars, Outer Planets) and Astrophysics (WFIRST), and this situation may adversely impact the Heliophysics Decadal Survey which will be released shortly.

The Planetary program has been singled out for a massive reduction, by 21% in FY 2013 with further reductions in the out-years. The flight rates of the highest priority programs, Discovery and New Frontiers, will be drastically reduced and there are insufficient funds in the out-years to operate the expected fleet of flight missions. The Mars Exploration Program will take the brunt of the reductions with the elimination of the 2016/2018 joint Mars missions with ESA. The Outer Planets program is reduced to study concepts.

Dr. Boss said it was "befuddling" why NASA's Planetary Science program had been singled out. Dr. Squyres asked if others concurred with the Finding. All did so.

Dr. Boss then presented the first recommendation:

Recommendation: Recovering the Planetary Exploration Program

The Science Committee recommends that NASA seek restoration of funds in its FY 2014 budget proposal to repair the damage done to the Nation's robotic planetary exploration program within the context, but not at the expense of a balanced science program that has already absorbed numerous funding reductions in recent years.

The Committee concurs with SMD's initiative to reformulate the Mars Exploration Program for missions in 2018-2020 in partnership with human space flight, technology development, and potential international partners, pending any Congressional direction and under the condition that the plan must be consistent with Decadal Survey recommendations.

Mr. Kohrs sought confirmation that the NAC would not seek restoration of the FY 2013 funds. Dr. Ballhaus said FY 2013 funding was a "done deal." Mr. Kohrs added that he regarded Mars as a prime destination. Dr. Ballhaus said he doubted anyone at NASA Headquarters wanted to forego Mars. Dr. Squyres asked if all were in agreement on the recommendation: all were. This recommendation was approved.

Dr. Boss then presented the second recommendation:

Recommendation: Restoring Science in NASA

The Science Committee recommends that NASA advocate and pursue a policy within the Administration that will place NASA science at the same priority level as science in other agencies such as National Science Foundation (NSF), Department of Energy (DOE) and National Institute of Standards and Technology (NIST), and be included in any future initiatives that seek to increase the science investment for the Nation.

Dr. Boss stated that NASA should be included on the same priority level as NSF, DOE and NIST. Dr. Ballhaus asked what budget share does NASA currently spend on science? Dr. Boss estimated it at 25 percent. Dr. Ballhaus said his "rose-colored" view was one-third; the actual figure was 25-28 percent. Dr. Squyres commented that if one looked at the America Competes Act, NASA faced flat funding. This, he added, meant that inflation would bring a decline, despite the priority being placed on international competitiveness. Mr. Hanisee expressed concern that this recommendation was duplicative. Ms. Smith suggested a word was missing: the step sought was to increase funding for NASA science, not for NASA as a whole. Dr. Squyres said he believed the committee's first recommendation was a very strong one; this second further recommendation might impinge in ways the committee had not discussed. This recommendation was not approved.

Dr. Boss then presented the third recommendation:

Recommendation: Enhanced Cooperation in Planetary Protection

The Planetary Protection Working Group (PPWG-ESA) and the Planetary Protection Subcommittee (PSS-NASA) recommend that NASA and ESA renew the Letter of Agreement and further explore mechanisms for more closely coordinating their required planetary protection activities, including technology-development, with the goal of achieving high degrees of coordination and cooperative technology development for planetary protection to ensure most efficient use of available resources. Further, they recommend that the PPWG & PSS continue joint activities in planetary protection, including the regular exchange of meeting minutes and holding joint advisory meetings approximately every 2 years.

Dr. Boss said he thought this should be directed to U.S./European Union cooperation, so that planning was collaborative and both sides met together occasionally. He noted the current letter of agreement should be extended when it expired. Dr. Squyres said he thought this was a great example of a recommendation coming from the committee level, and urged its acceptance. This recommendation was approved.

Dr. Boss then presented the fourth recommendation:

Recommendation: Mars Science Laboratory (MSL) Planetary Protection Lessons Learned Report

The Committee requests the preparation of an extensive "lessons-learned" report be completed while the MSL Planetary Protection team remains intact and available for preparation of the report. The report should include:

- *Issues with spacecraft materials and contamination control that may affect measurements made either in situ or after return*
- *Key elements of a bioburden accounting software package that can be developed jointly for use in the Mars Sample Return (MSR) campaign*

- Publication of the Adenosine Triphosphate (ATP) assay as related to the NASA Standard Assay, to facilitate adoption of this assay for bioburden accounting on MSR elements
- Research needed to improve the assessment of proposed landing sites in the context of concerns for liberation of fluids from hydrated or frozen ground in the presence of a Radioisotope Power System.

This recommendation was approved.

Dr. Squyres thanked Dr. Boss for his report and recommendations.

Aeronautics Committee Report

Ms. Marion Blakey, Chair

Ms. Marion Blakey presented her committee's composition, the President's FY 2013 proposed budget for Aeronautics, and the committee's primary areas of interest. One key was "green aviation," which attempted to raise fuel efficiency and reduce aircraft noise. She presented photos of the San Francisco airport where a NASA program was synchronizing aircraft descent, which increased landings while reducing fuel use and noise. The central points of "green aviation," she reported, were to minimize energy use, minimize the impact of energy use, and minimize noise. She noted that NASA intended to develop revolutionary fixed-wing aviation capabilities, including use of alternate fuels. Internationally, she noted that the International Air Transport Association [IATA], which represented carriers responsible for 84 percent of air traffic, had established the environment as a top priority. She noted that by 2050, the IATA vision called for carbon-neutral growth. Doing so, she said, would force IATA members to investigate biofuels. A NAC member asked what percentage of total carbon burden did aviation cause. Ms. Blakey said between two to three percent; however, if one assumed growth in air travel and a decline in other forms of transportation, then the percentage attributable to aviation would rise. Dr. Smarr said that one's carbon footprint was dominated by air travel.

Ms. Blakey spoke next to "green aircraft," saying NASA was working with Boeing, Northrup Grumman, and Lockheed Martin to conceptualize aircraft that reduce noise, emissions and fuel burn. Key technologies included innovative flow control, advanced composites and better integration of airframe and engine. The technical priorities included development of laminar flow control concepts, drag reduction, and a 10 percent decrease in aircraft weight. Ms. Blakey then discussed pending "green operations." Cutting back on the throttle – taking a straight path down – was difficult, and perhaps was best achieved by the United Parcel Service into Nashville, where the aircraft appeared to arrive as "a string of pearls." Ms. Blakey called attention to the Integrated Portfolio Approach, explaining that technological improvements must be implemented into the systems for "green impact" to be achieved. She noted that retrofitting was a slow process.

Ms. Blakey presented the Aeronautics Committee's finding:

The Committee fully supports the research NASA's aeronautics program is conducting in the area of Green Aviation. The Committee understands the challenges related to noise reduction and reduction in emissions (CO₂, NO_x, and other harmful particulates) and compliments the Aeronautics Research Mission Directorate's [ARMD's] approach to address the challenges from a system wide perspective that considers both vehicles and operations. The Committee is encouraged by the efforts to capture the results of systems analyses and trade studies/sensitivity analysis. Understanding the market space and economics are key to identifying the correct technology barriers that need to be addressed. To help demonstrate and test potentially high risk technologies that are developed, it is important to establish strong collaborative partnerships with other government agencies and industry. NASA Aeronautics is continuing with its portfolio review and assessment, which the Committee fully supports and looks forward to the results as the assessment progresses, particularly in relation to investments in green aviation research. Additionally, the Committee was briefed on NASA's research on Hybrid Wing Bodies. Given their efficiency and noise reduction potential, the Committee sees any future N+2 research in this area as promising.

Dr. Squyres said this finding was non-controversial and looked great. Ms. Blakey said this was basically a "good news" report. The number of agencies involved in "green aviation" was enormous; some focused on alternate fuels; some on aviation design; and other areas. She noted that the Interagency Coordination Efforts on Alternative Fuels involved cooperation between researchers and policy makers. She described NASA's own work on alternative fuels.

Ms. Blakey presented the Aeronautics Committee's second finding:

The Committee is very pleased to see ARMD's proactive leadership to help form strong coordination and collaboration in research between NASA and other government agencies concerning the use of alternative fuels for aviation and hopes that coordination and collaboration will continue. The Committee believes the coordination effort to date is re-affirming NASA's role in conducting research to characterize alternative fuels including emissions characterization and to develop fuel-flexible combustor technologies.

Ms. Blakey stated she had learned of rather remarkable steps forward in creating fuel efficiency standards for aircraft; no such standards exist. Dr. Squyres said he welcomed Ms. Blakey's second finding. Ms. Blakey then reported on the status of the Unmanned Aerial Systems [UAS] Subcommittee. UAS, she said, was a relatively new area of research focused on unmanned or remotely-piloted vehicles. She noted that the group had added an expert in manufacturing. The group's first meeting had been held December 20, 2011.

Ms. Blakey closed by presenting the group's work plan for 2012. Dr. Squyres said he thought excellent work was being done. He noted that other countries had claimed that NASA's actions constituted an unfair subsidy of U.S. aircraft manufacturers. Did Ms. Blakey foresee problems? She replied that important shifts had occurred over how NASA allocated its time with industry; "green aviation" could not be done without cooperation of industry. She did not believe any current work was inappropriate. Audience member Tom Irvine [ARMD, NASA Headquarters] said Ms. Blakey's statement was "accurate." Some large contracts with industry in the 1990s included contractual arrangements that had limited rights to the data. This, he said, had caused problems with the International Trade Organization [ITO]. Such arrangements had since been eliminated; all contracts are competed and emphasis is placed on data sharing with the public.

Dr. Squyres thanked Ms. Blakey for her report.

Council Discussion

Dr. Squyres said the Council would discuss the next day the topic of fixed-price contracts; he urged committee members to consider possibly productive joint sessions that could be held between committees in the future. He noted that on the question of fixed-price contracts, he wished to restrict the Council's deliberations to the pending recommendation. With that, Dr. Squyres opened the floor for comment.

Ms. Blakey said she assumed at times the NAC might want to look into broader matters outside any particular committee. A case in point was the President's Import-Export Committee, which had a technical committee looking into reforming the International Traffic in Arms Regulations [ITAR]. The Administration, she said, was trying to reform the export control regime and the way it was enforced. She noted that at a recent Los Angeles meeting a contingent of academics wanted to address the "deemed exports" issue, which placed restrictions on access to university and industry environments for foreign nationals. She thought this might be a subject for the Council to consider. Possibly, legal counsel should be involved. She thought this was a government-wide issue rather than a NASA issue. Dr. Squyres said he had served on many committees that made "unhappy sounds" about ITAR; the general response was that the concern was not being raised at a high enough level. Perhaps the NAC was a high enough level. Mr. Hanisee said that previously, NAC had received presentations on ITAR; this, however, was a different group and different year. Dr. Squyres noted that the ITAR regulations were written with the best intentions during the Cold War, but have since had unfortunate consequences. People he knew had "banged head against the wall and only gotten a headache." He speculated that the current Administration may be more receptive. Dr. Ballhaus said the President could simply issue an Executive Order. Mr. Hanisee said his preference would be to move ITAR responsibility from the Department of State to any other department of the Federal Government. Dr. Smarr said that to the extent "deemed exports" interfere with NASA research, then that could be a specific area on which to build a case, as it was clearly within NASA's purview. Ms. Blakey strongly urged the group to focus on the deemed exports ITAR issue alone, and not go beyond it. "Deemed exports" were a "stepchild" of ITAR reform because the issues that were getting most of the attention were technology and trade. If the NAC looked at deemed exports, it might have an impact. She noted that some universities had turned down NASA work because their research teams include foreign nationals.

Public Input

Dr. Squyres asked if there was any input the members of the public might wish to offer, and there was none.

The NASA Advisory Council public meeting of Thursday, March 8, 2012, adjourned at 5:00 pm.

* * *

The NASA Advisory Council public meeting of Friday, March 9, 2012, convened at 8:00 am.

Call to Order, Announcements

Ms. Diane Rausch, Executive Director

Ms. Diane Rausch, Executive Director, called the meeting to order, and welcomed Council members and audience to the second day of the NASA Advisory Council. She reminded participants that the meeting was a public meeting held under the Federal Advisory Committee Act (FACA), and the guidelines announced the previous day remained in effect. All comments were considered to be “on the record.”

Remarks by Council Chair

Dr. Steven W. Squyres, Chair

Dr. Steven Squyres said he intended the NAC to meet three times annually – roughly in July, November and March. Recent meetings had been 1.5 days in length. With the reduction from four to three meetings a year beginning in 2012, the group might need two full days to conduct business. This need was strengthened by the need to hold cross-committee discussions in the future on such matters as “deemed exports.” NAC members consulted their calendars. The Council meeting dates that were agreed to for the remainder of 2012 were as follows: July 26-27 and November 29-30. The first meeting of 2013 was tentatively set for March 27-28, 2013, at NASA Headquarters. Ms. Rausch mentioned the NAC’s earlier decision to have all committees meet together once a year at the same location. Last year the first “all-hands” NAC meeting had been held at NASA Ames Research Center in California in August 2011. This year’s “all-hands” meeting will take place at Goddard Space Flight Center in July 2012. Ms. Blakey asked if it was appropriate to proceed with scheduling NAC committee meetings; Dr. Squyres said it was.

Information Technology Infrastructure Committee Report

Dr. Larry Smarr, Chair

Dr. Smarr noted that the IT Infrastructure Committee was a small committee; he was working with Dr. Squyres to enlarge it. Dr. Smarr said his committee’s first finding was:

To enable new scientific discoveries, in a fiscally constrained environment, NASA must develop more productive IT infrastructure through “frugal innovation” and “agile development.”

Dr. Smarr noted that, given fiscal restraints, NASA needed a new culture to keep up with developments. He believed the Federal Government had done a good job in getting technologies out into the commercial world. He believed social networks were revolutionizing the world; NASA products would not be used if they were less “friendly” than Twitter. NASA needed to create greater capacity from no greater investment. Dr. Smarr said NASA was falling behind Federal and Non-Federal institutions in IT. In the field of large data cyber-infrastructure, the rate of 10G/second had seemed large. Now, data was moving at 10 times that rate. NASA’s largest computation cluster was 264 Graphics Processing Units [GPUs]; the Japanese have deployed clusters of 4,000+. He noted that the world was moving in the direction of hybrid-multicore/GPUs; NASA had done no work in this area. The Chinese now owned the fastest computers in the world. Dr. Smarr noted various headlines:

- October 28, 2010: China takes HPC Heavyweight Title
- October 12, 2011: Jaguar is Getting a GPU Upgrade, to Make it the World’s Fastest Supercomputer Again
- November 14, 2011: NVIDIA Tesla GPUs to Accelerate NCSA Blue Waters Supercomputer

Dr. Smarr said it would take a huge software effort to make compatible all NASA codes that used High Performance Computing [HPC]; he doubted NASA had the capability to do this by itself. He urged that NASA partner with the NSF in optimizing data analysis. This, he said, would permit use of a data-intensive supercomputer based on SSD flash memory and virtual shared memory SW, with a system designed to accelerate access to massive datasets in being generated in science, engineering, medicine and elsewhere.

Dr. Smarr then spoke about maturing cloud capabilities beyond Nebula. He said the Nebula testing conclusions were a good first-step for evaluating the needs for science-driven cloud applications. The next major step was creation of a NASA Cloud Test-Bed. He noted that limited funding for this existed; he urged partnering with Johns Hopkins University, commenting that, “We have to learn from these people.” Dr. Smarr then spoke about the NASA corporate-wide area network backbone.” NASA currently has just one 10/G link, a dedicated line connecting Ames Research Center with Goddard Flight Space Center. DOE was engaged in creating 100/G links, with funding from the Federal Stimulus Act. DOE wanted to pursue Federal partnerships, including with NASA. NASA, he said, was currently a considerable distance from the “leading edge” in the field. Dr. Smarr spoke of possible international partnerships with the Global Lambda Integrated Facility.

Dr. Smarr said the IT Infrastructure Committee's first recommendation was:

Recommendation

To enable NASA to gain experience on emerging leading-edge IT technologies, such as data-intensive cyber-infrastructure; 100 Gbps networking; GPU clusters and Hybrid HPC Architectures. [Additionally], we recommend that NASA aggressively pursue partnerships with other Federal agencies, specifically, NSF and DOE, as well as public/private opportunities.

We believe joint agency program calls for end users to develop innovative applications will help keep NASA at the leading edge of capabilities and enable training of NASA staff to support NASA researchers as these technologies become mainstream.

Dr. Squyres characterized this recommendation as "great." Mr. Kohrs asked about security problems. Dr. Smarr said DOE was at least as concerned with security as NASA; he believed NASA would profit from engaging with them. Dr. Boss asked whether "joint agency" referred to external programs. Dr. Squyres said he was only concerned that the wording be clear. The Council approved this recommendation

Dr. Smarr then presented his committee's second finding:

Science Mission Directorate [SMD] data resides in highly distributed servers

- *Many data storage and analysis sites are outside NASA Centers*
- *Access to entire research community essential*
 - *Over half science publications are from using data archives*
 - *Secondary storage needed in cloud with high bandwidth and user portal*
- *Education and Public Outreach of data is rapidly expanding*
 - *Images for public relations*
 - *Apps for Smart Phones*
 - *Crowdsourcing*

Dr. Smarr reported that the majority of Hubble-based papers were now derived from archived Hubble images. Archive use, he said, was the wave of the future. Dr. Smarr, referring to multi-mission data archives, predicted the quantity of data would double by 2018 and rise more steeply once JWST comes on line. He noted that the Solar Dynamics Observatory [SDO] recorded 57,600 images of the Sun daily; given the density of pixels, SDO was acquiring data at 20 times the rate of Hubble. Dr. Smarr reported on how the public could access data simultaneous to its acquisition. Space images were widely seen: Hubble had been a spectacular success, as had the Mars Rovers. He presented thumbnails of 32 of the 200 apps currently available that related to NASA. He described "Galaxy Zoo," saying 250,000 people had looked for and classified a galaxy, resulting in 60 million classifications by private citizens. This unfunded task created the largest-ever database of galaxy definitions. Dr. Smarr briefly discussed other data uses, noting that the NASA Earth Observatory integrated a variety of global variables for the past decade; that NASA's Earth Observing System Data and Information System [EOSDIS] data products distribution was approaching one-half billion a year; and that the NSF Ocean Observatory Initiative, which combined underwater and coastal sensors, distributed data to science, education and the general public.

Dr. Smarr then presented a draft of his committee's second recommendation.

Recommendation

NASA should formally review the existing national data cyber-infrastructure supporting access to data repositories for NASA SMD missions. A comparison with best-of-breed practices within NASA and other Federal agencies should be made.

We request a briefing on this review to a joint meeting of the NAC IT Infrastructure, Science and Education committees within one year of this recommendation. The briefing should contain recommendations for a NASA data-intensive cyber-infrastructure to support science discovery by both mission teams, remote researchers, and for education and public outreach appropriate to the growth driven by current and future SMD missions.

After Council deliberation, it was agreed that this recommendation should be completed following a joint meeting of his committee with the NAC Science Committee and the NAC Education and Public Outreach Committee, in July 2012.

Dr. Smarr said this review would determine data location; software structure used; comparisons with what other Federal agencies are doing; and what recommendations should be made for modern architecture. Data sophistication varied considerably across SMD; further, data mining had expanded considerably in the past decade. Dr. Squyres said that while the intent of this recommendation was great, he had two concerns. First, to list the specific individuals to be involved ran counter to the Administrator's prerogatives. Second, was there any precedent for the NAC to direct NASA to prepare a written report for the Council? Ms. Rausch, NAC Executive Director, said she was unaware of any such requests in the past. Dr. Squyres said this

recommendation was setting a precedent. Ms. Rausch suggested that perhaps the NAC should seek a NASA future briefing on the matter instead; Dr. Squyres agreed. He suggested that Dr. Smarr “wordsmith” the changes needed. Dr. Alan Boss said the NAC Science Committee (including the Chair Dr. Wesley Huntress and member Dr. Byron Tapley), was “a bit leery” of this proposal. They hoped no action would be taken prior to a joint meeting. Dr. Squyres said this was an important concern; he urged the IT and Science Committees meet jointly at Goddard Space Flight Center in July 2012.

Ms. Blakey asked what concerns regarding data scientists had. Dr. Boss said many scientists were protective of their data; having spent a decade developing an instrument, they felt some right to exclusive initial access. Dr. Squyres said this was a subject about which he was passionate. Before his Mars Rovers had landed, all images went straight to the Web for use by anyone. There had been concern that “our team” would get scooped; this has not happened once. Further, one needs to be aware that passionate amateurs have grown up around this data. Dr. Squyres noted that he received at breakfast that morning information from amateurs in Belgium who had created products while he was sleeping. He believed it important that the pertinent NAC committees meet together to discuss this recommendation further. Mr. Perkins said the Education Committee would like a seat at the table as well, to which Dr. Squyres agreed.

Technology and Innovation Committee Report

Dr. William Ballhaus, Chair

Dr. William Ballhaus said his committee included “all NASA programs that could benefit from technology research and innovation.” His committee would likely make a recommendation at the next Council meeting in July 2012. He presented three questions for the NASA Administrator. He observed that most organizations had “rules of thumb” as to how funds should be invested. The first question was: What is the appropriate technology investment for NASA? The second question was: What fraction should be reserved for “seed corn”? He noted that if seed corn was not fenced off, it gets eaten. The third question was: How is NASA managing its core competencies?

Dr. Ballhaus and his committee believed a lot of progress had been made recently. At one point, the NASA Space Technology Program had been decimated; now, it was coming back. Still, he found the general state of things a bit alarming. The Space Technology budget was set at \$575 million. He identified the “big nine” projects:

- Laser communications
- Cryogenic propellant storage and transfer
- Deep space atomic clock
- Large-scale solar sail
- Low density supersonic decelerators
- Human exploration telerobotics
- Composite cryogenic propellant tanks
- Hypersonic Inflatable Aerodynamic Decelerator [HIAD]
- Robotic satellite servicing

He presented milestones for each project. Each technology needed to be linked to a user so that a “pull” was created. He believed in early “mercy killing” – effective organizations quickly eliminate programs that fail to meet deadlines and expectations. Ms. Blakey noted that robotic satellite sensors were a Congressional earmark. It was noted that NASA budgets may be influenced by the deorbiting of the Hubble Space Telescope, which could cost as much as \$500 million.

Dr. Ballhaus then reported on actions in progress through the Office of Chief Technologist [OCT]. These included:

- Finishing accounting process of Agency-wide technology investments portfolio.
- Analyzing NRC Report. He thought some adjustments to the NRC report would be necessary. He noted that the Agency was already investing in the 16 highest technologies, but was under-investing in some of them
- Preparing Strategic Technology Investment Plan. This, he said, would work back from NASA strategy and roadmaps and NRC review of those roadmaps

The Technology and Innovation Committee presented a series of observations, including the following: NASA’s “grand” missions are technology-enabled. JWST, MSL and ISS are the type of work NASA should do and that only NASA is capable of such work. However, Dr. Ballhaus quoted the recent NRC Report on NASA Space Technology Roadmaps: “Future U.S. leadership in space requires a foundation of sustained technology advances . . . NASA’s technology base is largely depleted.” Dr. Ballhaus noted that, in all, \$1.3 billion had been taken out of NASA’s technology effort. What, he asked, was the appropriate percentage of the full NASA budget that should be addressed to technology? He said there appeared at present to be no way to answer that question. He believed the answer to that question should follow from a considered discussion; that discussion might be based on a recommendation from this committee.

Dr. Ballhaus identified three categories of technology effort:

- Mission Support/Pull – Mission specific or vehicle/architecture specific in the mid-to-high TRL range
- Cross-Cutting – In the mid-to-high TRL range; e.g. cryogenic fluid management in space, solar electric propulsion
- “Seed Corn” – Low-to-mid TRL projects, in which one develops people as well as maintaining core competencies, and which could be “game changing” activities

Dr. Ballhaus quoted a second statement from the recent NRC report on NASA Space Technology: “NASA needs a disciplined system analysis for management of the space technology portfolio.” He added that NASA needs an Agency- wide capability to assess the full potential benefits of a technology. Dr. Ballhaus noted that it took a long time to invest in capabilities. Further, it requires well-trained people and the employment of the appropriate processes and facilities. The question, he said, was: who is responsible for tracking how core competencies are maintained? With respect to the laboratories, he said, the decision was to maintain a set of core competencies and to fund these off the top. Then, when NASA went to full-cost accounting, this became difficult to do. He noted that while most technology efforts were good, some turned on maintaining a laboratory capability that had nothing to do with NASA’s overall direction. He noted that he had never seen an NRC response to NASA’s laboratories report; it would, he said, be great to have one. Dr. Ballhaus restated his committee’s key questions:

- What is the appropriate investment level in technology?
- What fraction should be reserved for “seed corn”?
- Who is managing core competencies?

Dr. Smarr asked if much effort was made to exploit technologies in partnership with other agencies. NASA needed to move in that direction. It was noted that while “all of us wear the government jersey,” coordination was often difficult. Dr. Smarr said Congress could thwart collaboration by telling an agency: “We gave funds for that to *you*; why are you collaborating with NASA?” Dr. Ballhaus said partnerships required great clarity as to intent; otherwise, they tended to wander. Reference was made to the earlier appointment of Dr. Robert Braun as NASA Chief Technologist; he had been given \$500 million to “ramp up” the program. Dr. Ball said Dr. Braun had been fairly effective in getting the program moving, but there had been some frustration because Dr. Braun was focusing on process development and others were looking for technology advancement.

Audit, Finance and Analysis Committee Report

Mr. Robert Hanisee, Chair

As an opening remark, Mr. Robert Hanisee said certain issues never went away, such as unfunded liabilities and environmental issues. Mr. Hanisee then outlined Earned Value Management [EVM]; its aspects, purposes and planned rollout. Each NASA Center should not develop its own EVM system, or else “we are going to be a Tower of Babel.” There was to be a single system for the entire Agency. Currently, the plan was in rollout. He presented the schedule for EVM capability implementation, noting that maintaining system-wide consistency was the real challenge.

Mr. Hanisee presented the Presidential Memorandum on the Disposal of Unneeded Federal Real Estate. This memorandum sought to eliminate unnecessary expense, save energy and water, and reduce greenhouse gasses. The cost saving goals, he said, were 10 percent by 2020 and a 15 percent reduction in current replacement value by 2055. NASA, he said, faced an enduring problem. It was a relatively old Agency and needed to plan how to renovate or remove older buildings. As long as buildings stood, NASA was obliged to maintain them. The goal for 2015 was that at least 19 percent of NASA buildings be less than 40 years old. The 2015 target 19 percent was raised to 32 percent by 2028 and 63 percent by 2055. Mr. Hanisee presented a list of real property disposals: high dollar amounts were associated with White Sands Space Harbor, Las Cruces, New Mexico [\$3,800K], which was being returned to the Army; and the Orbiter Production and Maintenance Facility, Palmdale, California [\$991K], whose lease was not being renewed. Disposal of the Santa Susana Field Laboratory in Ventura County, California remained complicated by on-site pollution issues; it might prove necessary to remove everything down to the bedrock. One option was to fence off particular buildings and let them “rust in place.” An asbestos removal requirement fell due in 2013; with aging buildings, it was often more cost-effective to tear them down than to undertake asbestos removal.

Mr. Hanisee then turned to Kennedy Space Center [KSC]. He reported that commercial space operations would likely be handled from KSC. This would keep equipment and training available for some future NASA activity. Mr. Hanisee noted a request from Space Florida to operate from KSC. KSC, seeing this operation as a good fit, had signed a 15-year permit under Space Act authority to partner “with other public and private agencies and instrumentalities in the use of services, equipment, and facilities.” An agreement covering reimbursable services was in the works.

Mr. Hanisee then addressed the topic of unfunded environmental liabilities. This issue never went away, in part, because the Agency had adopted a model with which its accountants were uncomfortable. Unfunded environmental liabilities had been a significant NASA deficiency in every external audit report of the past eight years. External auditors, he said, wish to impose rigorous examinations even if the data is 50 years old. In 2011, he said, the level of unfunded environmental liabilities was

\$1.023 billion, up from \$893 million the previous year. He noted that some of the liabilities stretched out for 50 to 100 years. The three largest liabilities were Santa Susana Field Laboratory, KSC, and NASA Headquarters. Ms. Blakey asked if the dollar increase reflected setting a higher bar or discovering additional problems. Mr. Hanisee said both, plus better assessment tools. He expressed some frustration, saying that if someone told him what it would cost to remediate a problem 50 years hence, he would tell them they were wrong. Vast changes in technology and technique would occur in the interim. The numbers he had supplied, he said, were at best a guess, but one has to have a systematic way of making guesses to satisfy the auditors. Mr. Hanisee then discussed the transition of the Space Shuttle which included 1,134,889 line items; the vast majority will be turned over to the General Services Administration [GSA] once declared safe. He said he expected that the Space Shuttle should drop off "the list of worries" by next year.

Mr. Hanisee then reported the "good news" that on November 15, 2011, the firm of Price Waterhouse Cooper had given NASA an unqualified audit opinion, following seven years of disclaimers. Mr. Hanisee commented: "This is the gold standard. It was a long slog; it took longer than we expected, but their finding was that there were no material weaknesses." Two deficiencies were noted, he said: the estimation of environmental liabilities and the monitoring of SAP use. Mr. Hanisee noted that NASA had vast physical holdings; much of which was physically in the hands of private contracting firms. Supposedly, such firms kept good records; often, they did not. Price Waterhouse had urged "closure of deficiencies related to controls over property, plant and equipment maintained by contractors." He noted of the previous year's lesser findings, 12 of the 14 financial findings had been closed, as had 9 of the 10 IT findings.

Mr. Hanisee reported one "last minute" surprise. Some years back, Price Waterhouse had gone to the accounting oversight board to argue that once a satellite had been launched, it should not be amortized over time. The Federal Accounting Standards Advisory Board [FASAB] had agreed with this; NASA began to write off the associated costs. Price Waterhouse held that there was one satellite that remained operational and that NASA should go back and recapitalize it. Mr. Hanisee stated that, in general, one did not want to go back to an earlier method; however, time was short and the Agency had the data to meet the request. Dr. Squyres asked of the auditors were concerned about creating a precedent regarding commercially-launched craft. Mr. Hanisee said yes.

Mr. Hanisee said NASA's biggest problems related to property, plant and equipment accounting. The original rules did not require capitalization; costs were charted through a number of Centers; the data was not good. The reason commercial companies capitalize is to match cost of asset to future revenue. Otherwise, the series of sharp ups and downs is produced. While this made sense in the private sector, it makes no sense in government – money is gone and it's not coming back. Two years ago, NASA sought some kind of relief from the FASAB, which issued a warning that a "best estimate" would suffice. Mr. Hanisee cited two areas of emphasis in year-end report – environmental liabilities and grant accounting with universities. Regarding the latter, he said problems occurred because Principal Investigators often failed to closeout grants once funds had been expended. The approach, that an individual would not get another nickel if they had an open grant, had not been fully successful. He noted that some NASA people liked to maintain open grant lines for continuity. Dr. Smarr said NSF would not award a new grant unless previous grants had been closed and all reports filed. Regarding environmental liabilities, Dr. Ballhaus asked if it was possible to fence off Santa Susana Field Laboratory. Mr. Hanisee said it was not possible, as the asbestos remediation was still required.

Mr. Hanisee noted that there is only one thing worse than not getting a clean audit, and that is getting a clean audit, and then losing it the following year. He added these additional comments: First, NASA was not to compete with the private sector. Rather, it did things private sector could not do. At times, he said, the line between the two was fuzzy. Second, he believed NASA undercharged for support it provided to others. Ms. Hanisee then addressed the FY 2012 Administrative Savings Initiative. This required a \$100 million reduction in NASA's budget; about \$17 million of which came out of travel. A more recent order called for \$200 million in savings in 2012. That, he said, would be "a tall order." He noted that many science and engineering staff were unhappy with the travel cutbacks. Dr. Squyres reported hearing complaints from people unable to attend professional gatherings. Did it matter, he asked, where the \$100 million came from? Savings could be realized if the number of individuals who had desktops; laptops; iPod; Blackberries and additional electronic tools was reduced. Perhaps a NAC committee should make a recommendation in this area. Dr. Ballhaus added that the development of simplified graphics technologies might mean the NASA graphics department was overstaffed. Could reductions there count against the \$100 million target?

Mr. Hanisee said his committee had no recommendations to make at this point. He did note one personnel matter. Mr. Terry Bowie, NASA Deputy CFO, retired last week; at the same time, Bruce Ward, Associate Deputy CFO, had moved to the Department of Agriculture. These two individuals had contributed greatly to recent Agency progress. He was certain many qualified people would be applying. However, his committee had urged Administrator Bolden to select someone with a strong accounting background, to complement CFO Elizabeth Robinson's background in budgeting.

Roundtable Discussion: Council Plans for 2012

Dr. Steven W. Squyres

Chair, NASA Advisory Council

Dr. Steven Squyres offered several opening comments. He believed the issue of fixed-price contracting should be set aside for the moment to allow Ms. Smith's Commercial Space Committee to discuss it; he noted that no decision was needed prior to the scheduled July meeting. He thought it would be a great help if the Human Exploration and Operations Committee and the Audit and Finance Committee were in contact with the Commercial Space Committee, and perhaps held a future joint meeting. The recommendation was tabled until the July Council meeting.

Dr. Squyres noted that there were two topics on which he would like to move. The first was ITAR. He did not consider it a matter on which a recommendation should emerge from a single committee, because it was such a cross-cutting topic. He also thought that the NAC, rather than taking on the entire ITAR issue, should focus on the issue of "deemed exports," which more directly affected it. He was, he added, compiling a short list of sources for presentations to the NAC on this topic. He suggested this be on the July agenda. Mr. Hanisee recommended a member of his Audit, Finance, and Analysis Committee, Mr. Howard Stanislawski, an attorney with the Washington D.C. law firm of Sidley Austin, who had expertise in aerospace regulatory requirements, including ITAR. Dr. Ballhaus requested additional background on the subject; Dr. Squyres and Ms. Rausch said they would collaborate on assembling a background package. Dr. Squyres, citing ITAR as an example, expressed the view that he thought it probable that multiple committees would engage on a given topic.

The next item was the rewording of the third recommendation from the Human Exploration and Operations Committee the previous day. The new wording presented was:

Recommendation

Identify an existing ISS international partner[s] to accelerate expansion of international participation in future deep-space exploration planning. This expanded partnership will bring international resources to exploration and enhance sustainability. For any mission that is selected, we need additional hardware beyond the SLS and MPCV such as a lander, a habitat, advanced propulsion systems, etc.

This recommendation was approved by the Council.

A NAC member sought clarification on how recommendations reached NASA Administrator Charles Bolden. The response was that the recommendations were part of the written report normally given by the Council Chair to the NASA Administrator, from whom a written response from the NASA Administrator was received.

Mr. Kohrs said he was reminded again that the international partners were part of the discussion. Dr. Smarr said given the criticality of the issue, the NAC might be well advised to seek a briefing on the pluses and minuses of establishing an asteroid or planet as a destination. He was curious to know what the current NASA thinking was on this. Mr. Kohrs noted that NASA Administrator Bolden had appointed Mr. John Shannon, previous manager of the Space Shuttle Program Office, to undertake a review. He believed it might be wise to invite a presentation from him. Dr. Squyres said he thought this was an example of a true cross-agency matter. Dr. Squyres noted that all matters carried over from the previous day had been addressed. He wished to go around the room to see what matters might be on the minds of NAC members.

Dr. Boss said all his important comments had already been made. He was quite pleased that four of the five recommendations had been accepted. He thought the Science Committee would be pleased with the session. Dr. Squyres said he recognized that JWST had not been designed to be serviceable, as Hubble had been. Dr. Boss said that if JWST was in an earlier phase, he would consider the addition of a grapple to be fine. Now, however, the last thing the mission needed was a change order. It would be wonderful to have JWST serviceable; the value of this to Hubble has been great. Dr. Boss said he had no idea what servicing by an astronaut could be to JWST; perhaps others should be asked. Dr. Smarr said JWST's engineering was such that everything was bolted together and could not be removed as components. It was not designed to be serviceable. He noted that even with Hubble having been made "serviceable," it was not easy to service. Dr. Squyres imagined a circumstance in which an astronaut could correct a failed deployment; he had been repeatedly impressed by the ingenuity of the crews engaged. Dr. Boss commented that SMD was interested in getting a new heavy lift launch vehicle that would allow for larger fairings. This would have a big impact on SMD capabilities.

Mr. Hanisee said he had made his points either during the Council meeting or at dinner.

Mr. Perkins thanked Dr. Squyres for a well-run meeting. He believed the work of his Education and Public Outreach Committee was going to take a lot of coordination, and hoped to be able to reach out to other Council members for solutions. Ms. Smith offered her help in any way she could. Dr. Squyres said all Council members needed to regard the NAC not simply as an advisor to NASA, but as an advisor to itself, as well. Dr. Ballhaus commented that as NASA proceeded through a "flat budget"

environment, it might have to let go of some core competencies. Individual Centers might be clear as to what their competencies are, but a broader NASA view of this subject was needed. Ms. Smith said any understanding that was developed of this subject would be of interest to all. The question was raised as to whether the NAC had ever received a report relating to core competencies and NASA hiring practices. Ms. Rausch said that NASA Human Capital had provided at least one such report several years ago, which noted that NASA Centers were frequently hiring from nearby educational institutions rather than from a national pool of applicants.

Mr. Kohrs said that the biggest drawback was that every time it appeared things were “set,” the Agency was placed under Continuing Resolution, which “upsets the ballgame.” He noted that his committee would go to MSC, KSC and JSC and “dig a little deeper.”

Dr. Ballhaus noted that when the review was done of NASA’s Office of Program Analysis and Evaluation [PA&E], the concern was raised that the backup process appeared to interfere with milestone decisions. He believed real benefits flowed from this interaction and wondered if it was still a problem. He noted that the process involved engaging senior people, but added that a lot of these folks are just who are needed. Dr. Ballhaus said it was important to avoid the flawed review that had occurred with JWST. Among other things, clear lines of authority were needed. A strong independent assessment was needed at major milestone decision costs, and cost estimates had to allow for adequate reserves.

Ms. Smith described it as a great meeting; she was looking forward to fuller interactions. Her committee would have recommendations to make at the July 2012 meeting; they had been very impressed with what they had seen at Marshall Space Flight Center.

Dr. Smarr said his only concern from Dr. Boss’s briefing was that NASA had had a very robust Mars program; with this restructuring and the absence of outer planet missions, this is quite different. He felt the need for an official briefing over what NASA will be undertaking in the solar system – Mars, in particular, but the Outer Planets as well. This was a major aspect of NASA and the NAC needed to have a clear view of what was planned for the next decade. Dr. Squyres commented that things were very much in flux. Dr. Smarr suggested that “once the dust settles” – whether that is by July or by November – there was a need to develop a strategic organizational roadmap. Future directions, he noted, had been changed twice.

Dr. Ballhaus said that SMD was waiting for the launch of JWST, which would remove a huge number from the NASA budget. He believed the Agency would be treading water in Astrophysics and Planetary Science until 2018. He regretted this circumstance, but said it was the circumstance in which the Agency found itself.

Dr. Squyres said he believed the biggest issue was the absence of a clearly articulated goal and the lack of a clear technology pathway to meet that goal. Following from that, he added, was the inability of NASA as an Agency to understand why this should be a priority concern. This was absolutely huge. He believed that doing it right ensures the future of the Agency; doing it wrong threatens the future of the Agency. He closed by stating that he anticipated enjoying his position as NAC Chair and expressing appreciation to Council members, the Council Executive Director, and all those whose efforts resulted in the very productive NAC meeting..

Public Input:

A member of the public, Mr. John Emond (a recently retired NASA employee) provided comments via dial-in telecon. He called attention to the importance of public access and information dissemination on NASA Advisory Council activities, and said he was glad it would be continued in the future. He added that the Council meeting had been most interesting.

The NASA Advisory Council public meeting of Friday, March 9, 2012, adjourned at 12:00 noon.



NASA ADVISORY COUNCIL

PUBLIC MEETING

**NASA Headquarters
300 E Street, SW
Washington, DC 20546**

March 8-9, 2012

Agenda

Thursday, March 8, 2012

8:00 – 8:03 am	Call to Order, Announcements	Ms. Diane Rausch Executive Director NASA Advisory Council, NASA HQ
8:03 – 8:15 am	Opening Remarks by Council Chair	Dr. Steven W. Squyres Chair, NASA Advisory Council
8:15 – 9:15 am	Remarks by NASA Administrator	Mr. Charles F. Bolden, Jr. NASA Administrator
9:15 – 10:15 am	President's FY 2013 Budget Request for NASA	Ms. Elizabeth Robinson NASA Chief Financial Officer
10:30 – 11:00 am	Council Discussion	
1:00 am – 12:00 noon	NRC Study on NASA Space Technology Roadmaps: Final Report	Dr. Ray Colladay, Former Chair Aeronautics and Space Engineering Board National Research Council (NRC)
12:00 – 1:00 pm	Lunch	
1:00 -- 1:45 pm	Human Exploration and Operations Committee Report	Mr. Richard Kohrs, Chair
1:45 – 2:30 pm	Commercial Space Committee Report	Ms. Patti Grace Smith, Chair
2:30 – 3:15 pm	Education and Public Outreach Committee Report	Mr. Lars Perkins, Chair
3:15 – 4:00 pm	Science Committee Report	Dr. Wesley Huntress, Chair
4:00 – 4:45 pm	Aeronautics Committee Report	Ms. Marion Blakey, Chair
4:45 -- 5:00 pm	Public Input	
5:00	Adjourn	

Friday, March 9, 2012

8:00 – 8:03 am	Call to Order, Announcements	Ms. Diane Rausch Executive Director NASA Advisory Council, NASA HQ
8:03 – 8:15 am	Remarks by Council Chair	Dr. Steven W. Squyres Chair, NASA Advisory Council
8:15 – 9:00 am	IT Infrastructure Committee Report	Dr. Larry Smarr, Chair
9:00 – 9:45 am	Technology and Innovation Committee Report	Dr. William Ballhaus, Chair
9:45 – 10:30 am	Audit, Finance and Analysis Committee Report	Mr. Robert Hanisee, Chair
10:30 – 10:45 am	Break	
1045 – 11:45 am	Roundtable Discussion: Council Plans for 2012, Work Plan, Meeting Schedule, etc.	Dr. Steven W. Squyres Chair, NASA Advisory Council
11:45 am – 12:00 noon	Public Input	
1200 noon	Adjourn	

Appendix B: NASA Advisory Council Membership

Dr. Steven W. Squyres – Chair, NASA Advisory Council
Goldwin Smith Professor of Astronomy
Cornell University

Dr. William F. Ballhaus, Jr. – Chair, Technology and Innovation Committee
President and Chief Executive Officer [retired]
The Aerospace Corporation

Ms. Marion C. Blakey – Chair, Aeronautics Committee
President and Chief Executive Officer
American Aerospace Industries

Mr. Robert N. Hanisee – Chair, Audit, Finance and Analysis Committee
Managing Director, Trust Company of the West

Dr. Wesley T. Huntress, Jr. – Chair, Science Committee
Director Emeritus, Geophysical Laboratory
Carnegie Institution of Washington

Mr. Richards Kohrs – Chair, Human Operations and Exploration Committee
NASA [Ret.]

Mr. Lars Perkins – Chair, Education and Public Outreach Committee
Entrepreneur

Dr. Larry Smarr – Chair, Information Technology Infrastructure Committee
Director, California Institute for Telecommunications & Information Technology
Professor, Computer Science and Engineering Department
University of California, San Diego

Ms. Patti Grace Smith – Chair, Commercial Space Committee
Patti Grace Smith Consulting

Dr. Charles F. Kennel – Ex Officio Member
Chair, Space Studies Board
National Academy of Sciences

General Lester L. Lyles [USAF, Ret.] – Ex Officio Member
Chair, Aeronautics and Space Engineering Board
National Academy of Engineering

Appendix C: Meeting Attendees***Thursday, March 8, 2012, Meeting***

NASA Advisory Council Members:

William Ballhaus
Marion Blakey
Alan Boss
Bob Hanisee
Rickard Kohrs
Lars Perkins
Larry Smarr
Patti Grace Smith
Steve Squyres

NASA Personnel:

Waleed Abdalati	NASA HQ
Jens Feeley	NASA HQ
John Grunsfeld	NASA HQ
Colleen Hartman	NASA HQ
Thomas Irvine	NASA HQ
Marla King	NASA HQ
Alan Ladwig	NASA HQ
Amy Kaminsky	NASA HQ
Doug McQuiston	NASA HQ
Michael Meyer	NASA HQ
Susan Minor	NASA HQ
Frank Peterson	NASA HQ
Diane Rausch	NASA HQ
Beth Robinson	NASA HQ
Bette Siegel	NASA HQ
Heather Smith	NASA HQ
Henry Throup	NASA HQ

Other Attendees:

Ray Colladay	National Research Council
Andreas Diekuios	European Space Agency - Washington DC Office
Bill Macbey	European Space Agency
Michael Maloney	National Research Council
Kim Terrill	Katz International Management Solutions
<i>[one illegible]</i>	

Friday, March 9, 2012, Meeting

NASA Advisory Council Members:

William Ballhaus
Marion Blakey
Alan Boss
Bob Hanisee
Rickard Kohrs
Lars Perkins
Larry Smarr
Patti Grace Smith
Steve Squyres

NASA Personnel:

Marc Allen	NASA HQ
Jens Feeley	NASA HQ
Mike Green	NASA HQ
D. Hendrickson	NASA HQ
Marla King	NASA HQ
Diane Rausch	NASA HQ

Other Attendees:

Michael Maloney	National Research Council
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Appendix D: List of Presentations

Aeronautics Committee Report – Ms. Marion Blakey

Audit, Finance, and Analysis Committee Report – Mr. Robert Hanisee

Education and Public Outreach Report – Mr. Lars Perkins

Fiscal 2013 Budget Estimates – Ms. Elizabeth Robinson

Human Exploration and Operations Report – Mr. Richard Kohrs

Information Technology Infrastructure Committee Report – Dr. Larry Smarr

Science Committee Report – Dr. Alan Boss

NASA Space Technology Roadmaps and Priorities – Dr. Ray Colladay

Commercial Space Committee Report – Ms. Patti Grace Smith

Technology and Innovation Committee Report – Dr. Bill Ballhaus